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Wildlife
Laboratory annual
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WILDLIFE LABORATORY

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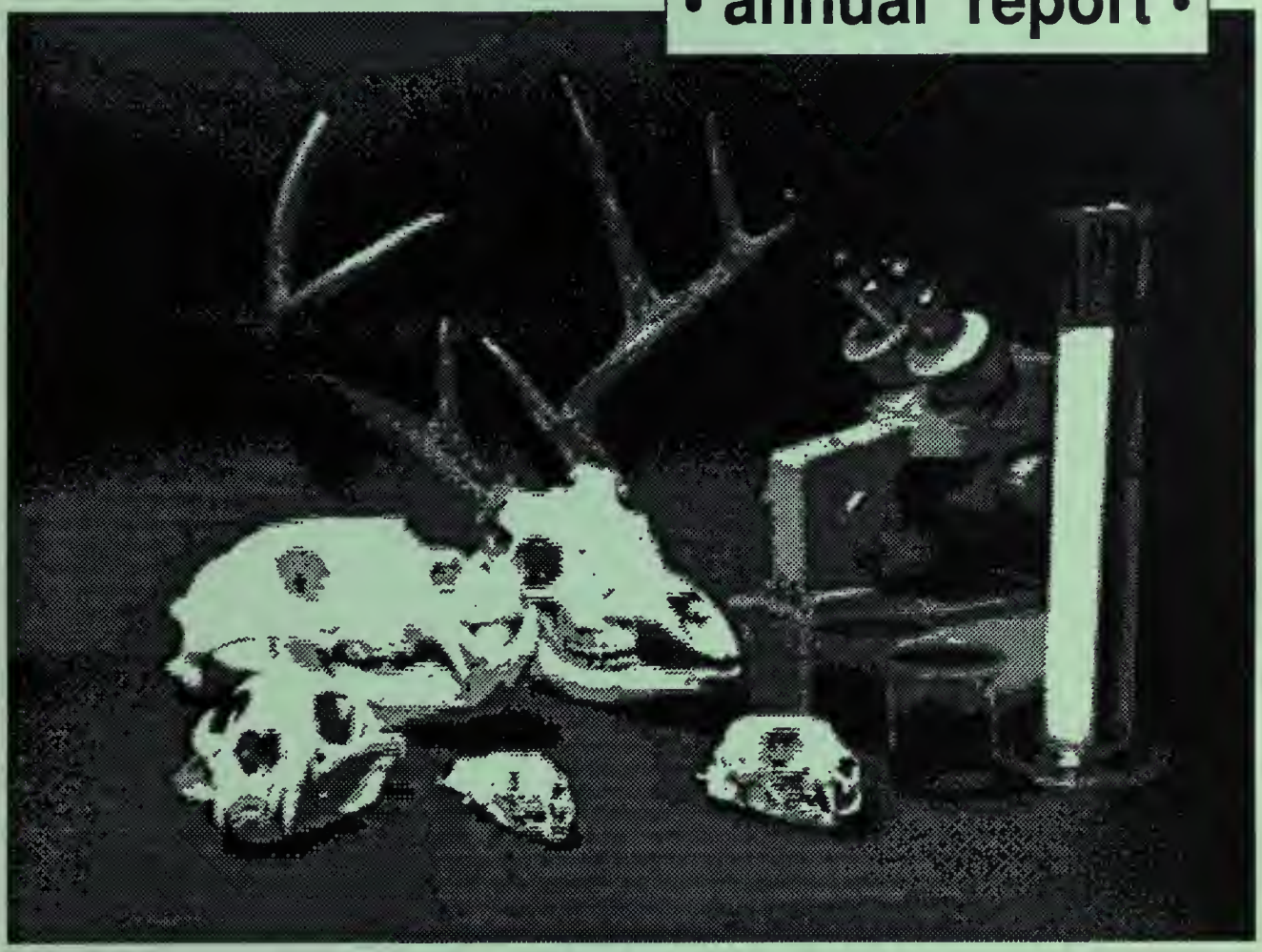

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JOB PROGRESS REPO

State: Montana

Project No.: W-120-R-15	Project Title:	Stat	
Element No.: VI	Element Title:	Wi	
Sub-project No.: 2	Sub-project Title:	R	
Study No.: Wl-1.0	Study Title:	V	
Job No.: 1	Job Title:		

Period Covered: July 1, 1992 - 1993

Prepared by: _____
Keith Aune

_____
Philip Schladweiler

Approved by: Terry N. Lonner
John P. Weigand
Don Childress

Date: December 12, 1993

Since this is a progress report only, results presented herein are not necessarily final and may be subject to change. For this reason, the information contained in this report may not be published or used for other purposes without permission of the Director.

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ABSTRACT

The wildlife laboratory processed 1,720 general wildlife specimens and 816 hunter/trapper specimens. Approximately 600 big game and furbearer samples were analyzed for food habits. Blood samples from 437 animals of several species were analyzed for disease and chemistry profiles. Reproductive tracts from 100 animals of several species were analyzed for reproductive performance. Approximately 400 skulls were cleaned to be stored in reference collections or used in wildlife education. Over 890 teeth were collected and submitted for age determination by cementum annuli counts. Ages were determined for 38 bear, 16 miscellaneous furbearing animals, 137 bobcat, and 343 mountain lion. Tests were conducted on aging techniques for these two species. Biological measurements, blood, and tissue were collected from bison harvested during the 1992-93 season. Tissue and/or blood samples were collected from 68 elk in two elk herds in Region 3 to test for various diseases. Laboratory personnel participated in a surveillance for plague and canine distemper in proposed black-footed ferret reintroduction sites. Fifty-nine animal necropsies were conducted on a variety of species. A total of $20,007 was grossed during the sale of 116 hides, heads, and other items auctioned in the annual trophy sale. Thirty-five laboratory reports were written reporting the results of hair analysis, necropsies, food habits analysis, and animal condition tests. Thirty-eight requests for reference specimens and educational material were processed. Materials for wildlife education were loaned out to teachers and wildlife educators 89 times. The biotelemetry frequency database was updated and results reported to the FCC frequency coordination committee. Animal immobilization throughout the state was coordinated. Work continued on monitoring of wildlife parasites through cooperation with the Veterinary Molecular Biology Laboratory. A pamphlet and special collection envelopes were developed for trichinella monitoring of black bears. Special research conducted included mountain lion, pine marten, and grizzly bear studies. Wolf, mountain lion, eagle, and grizzly bear mortalities were recorded. Management recommendations are presented.

INTRODUCTION

The wildlife laboratory has served research and management in Montana since 1955. The laboratory provides important services to wildlife biologists in Montana and conducts critical research on topics which must be investigated within a laboratory setting. Its history has been dynamic, developing with the ever-changing needs of wildlife scientists within the state.

Wildlife laboratory activities serve many functions. The laboratory produces valuable resources used in the Montana Department of Fish, Wildlife and Parks (MDFWP) information and education programs. It provides data and conducts research important to decision makers in wildlife management programs. The laboratory coordinates with other laboratories conducting similar work in neighboring states and

within the state. In addition, work at the wildlife laboratory assists law enforcement personnel during investigations of wildlife crimes.

This report summarizes the results of laboratory investigations for the period from July 1992 through June 1993, Fiscal Year 1993. The work conducted is ongoing and will continue into next fiscal year.

JOB OBJECTIVES

1. Provide wildlife laboratory services to management and research biologists through determination of food habits, reproductive status, sex, and age of wildlife specimens submitted from throughout the state.

2. Necropsy wildlife specimens suspected of being diseased, parasitized, or dying of unknown causes to identify the probable cause of death. This includes submitting various tissue samples to appropriate laboratories for testing if warranted.

3. Coordinate and supervise MDFWP wildlife immobilizing drug program and conduct research on new drugs as they become available.

4. Maintain and add to reference collections of plant and animal materials.

5. Coordinate MDFWP wildlife/pesticide program.

6. Coordinate and maintain a central file of radio frequencies being used to mark various species of wildlife throughout the state.

7. Obtain and prepare specimens to fill requests for study skins, tanned hides, mounted specimens, skulls, and other skeletal materials to be used by MDFWP personnel and others for educational displays and programs.

8. Assist other research and management biologists in construction of various animal markers and in capture and handling of animals.

9. Conduct special physiological investigations as requested:

    a. Test serological techniques of determining pregnancy in big game animals

    b. Test ultrasonic pregnancy detection devices for reliability and validity of detecting pregnancy in live big game animals

c. Relate physiological parameters of wildlife specimens to range condition, climatological factors, population structure and size, and various management strategies in various population units in the state.

METHODS

Food habits were determined using standard laboratory procedures: sampling, identification of food items using appropriate keys and known reference materials, volumetric measurement, and storage. Findings were returned to the original collectors for tabulation, interpretation, and final reporting.

Blood samples were obtained from big game animals during regular trapping and handling of animals for research or management purposes or from fresh hunter-killed animals. Hematology and blood chemistry measurements were done by the Livestock Department's Veterinary Diagnostic Laboratory in Bozeman.

Female reproductive tracts were prepared for examination, ovaries for sectioning, and bacula and testes for development. Uteri were examined for scars and embryonic or fetal tissue. Blood serum samples were submitted to the University of Idaho for measurement of pregnancy specific protein B levels.

Ages of ungulates were determined by tooth replacement, wear characteristics, and cementum annuli counts. Ages of bears, lions, and furbearers were determined by cementum annuli counts of sectioned teeth, skull characteristics, and/or radiographs. Radiographs were used to determine juvenile pine marten (Nagorsen et al. 1988), and adults were aged using cementum annuli counts.

Skulls of harvested bears and mountain lions and carcasses of marten from throughout Montana were required or requested to be turned in. Skulls of bobcat trapped in Regions 2 and 3 were collected. Skulls from these animals, plus those of other lions, bears, and furbearers received in the lab, were cleaned by boiling, aged, and returned to the hunter/trapper if requested.

Various hides, capes, antlers, horns, skulls, black bear claws, and elk canine teeth were collected and processed for sale at a public auction held in April 1993. A portion of these items were retained for preparation into display specimens or for educational purposes.

Bear and goat teeth were pulled, sheep and goat horns were measured, sheep horns were plugged for hunters, and furbearer pelts were tagged for trappers.

Various measurements and biological samples were taken from bison taken by MDFWP personnel during 1992-93 in cooperation with brucellosis surveillance conducted

by the Montana Department of Livestock. Work was primarily conducted under contract agreement with Wildlife Services, Bozeman, MT.

Liaison was maintained with other laboratories. Emphasis of this cooperation involved necropsy of specimens to determine cause of death and examination of wildlife for parasites and diseases. Tissues were collected to assist various genetic research conducted in other laboratories throughout the United States. Primary labs involved are the Veterinary Diagnostic Lab and Veterinary Molecular Biology Lab, both in Bozeman. Other labs to which specimens are sent include the National Wildlife Health Research Lab in Madison, Wisconsin; the National Veterinary Services Lab in Ames, Iowa; and The National Forensics Laboratory in Ashland, Oregon.

Disease surveillance was conducted in cooperation with the Southeastern Cooperative Wildlife Disease Study and the newly developing Western Wildlife Disease Cooperative. Program disease surveillance was conducted in cooperation with the Montana Department of Livestock and the U.S. Department of Agriculture Animal and Plant Health Inspection Service.

Statistical analysis was conducted using STATGRAPHICS software. Statistical significance indicates 95% confidence unless otherwise specified. Statistical tests used include ANOVA, Students t, or Chi-square as specified. Graphics were produced using HARVARD GRAPHICS software. Database management was conducted with DBASE III PLUS software.

Special Elk Disease Study

Tissues and blood were collected for a second year from hunter harvested elk. Prelabeled collection kits were assembled at the MDFWP lab. The collection protocol included collecting various tissues from generalized body regions. Blood was taken from the body cavity or heart and collected in one heparinized green top and two red top blood tubes. Heads were collected at check stations. Tissues collected from each head included parotid, mandibular, and retropharyngeal lymph nodes, and tonsils. From the thorax, a sample of lung, heart, and the tracheobronchial and mediastinal lymph nodes were collected. From the abdomen, various nodes including the hepatic and mesenteric lymph node plus spleen, liver, kidney, and ileocecal intestine were collected. Reproductive tissue collected from females included the ovaries, portions of the uterus, the fetus if present, and the udder and supramammary lymph nodes. A sample of amniotic fluid was collected from all pregnant elk. Testes and associated lymph nodes were collected from the few males sampled. Fecal samples were collected from each specimen. Samples were collected in clean plastic or whirlpak bags.

At the wildlife laboratory, tissues were cleaned, trimmed, and sectioned with half of each sample going into buffered formalin and the other half placed in sterile whirlpak bags and frozen. Lungs were palpated and examined for tubercular lesions. The liver

was serially sectioned and examined for parasites and lesions. All lesions were noted and sectioned out of lung or liver tissue for histopathological examination and bacteriology. Fetuses were counted and sexed, then saved for later measurement to determine conception dates. Blood samples were centrifuged and the serum poured into cryo-tubes. The heparinized blood was frozen and packaged for shipment to the National Veterinary Services Laboratory.

Culture work and histopathological examinations were conducted at the National Veterinary Services Laboratory. Blood serology was conducted at the State Diagnostic Laboratory in Bozeman. The MSU Veterinary Molecular Biology Laboratory/ Parasitology Section conducted the fecal flotations and Baermans of the feces.

Disease surveillance related to black-footed ferret (*Mustela nigripes*) reintroductions was conducted in the winter of 1992-93 near Malta, MT. The information regarding methods and results is compiled in a summary report presented in Appendix C.

RESULTS AND DISCUSSION

General Specimen Processing

One hundred seventy-two general wildlife specimens representing 20 species were submitted to the laboratory for various processing (Table 1). General specimens include those specimens other than special trapper/hunter collections. Routine processing protocols were followed depending upon species and requests by submittors.

Hunter/trapper submitted skulls processed this year included 353 mountain lion, 254 pine marten, 197 bobcat, and 16 miscellaneous furbearers. Non-hunting specimens examined and processed include 48 mountain lion, 40 bear, 11 bobcat, 24 bighorn sheep, and a variety of other species. Many of these specimens were prepared for educational materials to be distributed to wildlife educators throughout the state.

Eighteen bald and 22 golden eagle carcasses were collected and data compiled from each specimen to be submitted to the USFWS. A database was created to compile annual records of eagle mortalities submitted by MDFWP to the USFWS. Since 1986, the MDFWP laboratory has forwarded 47 golden and 35 bald eagle carcasses to the USFWS.

Food Habits

Approximately 30 rumens from deer studies in the Colstrip area and Bridger Mountains were fixed and stored. Biologists from the Bridger and Colstrip studies have examined and recorded the findings in their reports. The remaining rumens are stored and awaiting identification of contents.

Table 1. General specimens received and processed at the Wildlife Laboratory during Fiscal Year 1993.

Species	No. Processed	Percentage
Antelope	1	0.6
Bald eagle	1	0.6
Beaver	1	0.6
Bighorn sheep	24	14.0
Black bear	35	20.3
Bobcat	11	6.4
Coyote	2	1.2
Elk	4	2.3
Fisher	3	1.7
Golden eagle	2	1.2
Great horned owl	1	0.6
Grizzly bear	13	7.6
Moose	5	2.9
Mountain lion	48	27.9
Mule deer	4	2.3
Otter	5	2.9
Pine marten	1	0.6
Trumpeter Swan	2	1.2
White-tailed deer	1	0.6
Wolf	1	0.6
Wolverine	7	4.1
Total	172	100.0

Over 975 grizzly bear scat samples were collected by field projects and presented for analysis during the report period. The samples were accessioned and analysis was conducted on contract by Wildlife Services, Inc. (Kevin Frey). Coordination for processing these samples was provided by the MDFWP Wildlife Laboratory, and results were archived, then disseminated to various projects.

Nearly 200 stomach and colon samples from various species were examined and their contents determined. Approximately 88% of these were from marten submitted by trappers. Other samples examined include mountain lion, grizzly bear, and various furbearing species. These data will be analyzed further and summarized in later reports. Results of analysis of contents of marten stomachs and colons collected from the 1991-92 trapper harvest are presented in the Pine Marten Studies section of this report.

Nutrition

Blood samples were obtained from over 400 animals including elk, white-tailed deer, mule deer, bighorn sheep, moose, black bear, wolf, and grizzly bear. Serum biochemistries were run on these samples to determine normal background values and explore the possibility of using some of the parameters as an index to animal or herd condition. Test results were returned to the projects which submitted the samples and one copy retained in our files to be entered into a master computer database maintained at the laboratory. The data available in this master file will allow comparisons of herd condition between years and herd groups.

A database to compile information on blood biochemistries and hematology was updated and a data entry screen completed. The process of data entry will continue through the next year. Over 4,000 samples are recorded in the master file.

Animal Reproduction

Reproductive tracts were collected from various wildlife processed through the laboratory including otter, bear, lion, wolf, bobcat, fisher, and marten. Tracts are fixed and later examined to count corpora lutea and placental scars.

During the report period, 156 ovary pairs from pine marten tracts were excised and submitted to histologic sectioning by Matson's Laboratory. Results were not available for this report but should be presented soon.

Serum samples from deer and elk were stored and will be submitted for pregnancy determinations based on radioimmunoassay for pregnancy-specific protein B (PSPB). This technique has proven reliable in detecting pregnancy in domestic cattle and sheep as well as in free-ranging mule and white-tailed deer (Wood et al. 1986). The complete evaluation of various techniques to determine pregnancy rates is proposed for FY94. We expect to produce the draft of a publishable document comparing ultrasound, PSPB, and assays for progesterone at the end of FY94.

Fetuses were collected during tissue collections and from hunters in Hunting District 313 (N=66). The sex, length, and weight was determined for each fetus. Fetal age was determined for each specimen, and conception and birth dates were calculated. The data will be pooled with additional information from previous years and other areas to present in a separate report suitable for publication.

Age Determinations

During the report period, over 890 teeth were submitted to Matson's Laboratory for counts of cementum annuli. Teeth from 254 marten, 197 bobcats, and 61 coyotes were x-rayed to classify juveniles from adults. Results were filed and distributed to

various programs. Summaries of age structures are presented in the Bobcat and Pine Marten sections of this report. Results of cementum annuli counts were compared to other aging techniques when possible.

Tests were continued on aging of mountain lions using cementum annuli in the premolar tooth and aging pine martens with x-rays and cementum annuli in canine teeth. Results are presented in the Mountain Lion and Pine Marten Studies sections of this report.

Data from 85 known-aged grizzlies was compiled for summary analysis. A graduate student from MSU gathered the data and is working on analysis for graduate thesis credit. The analysis will compare known and cementum ages from specimens collected during the past 30 years. Additional comparisons will be made between 81 samples of multiple tooth sections from the same bear but in different years to evaluate success in determining cementum rings for intervals. Tooth sections from various teeth will be compared to detect difference in accuracy by tooth type. This analysis will be continued in 1994 to examine tooth sections from female bears with known reproductive histories. The file to date includes a potential of 20 different females from the Yellowstone and Northern Continental Divide Ecosystems.

Animal Immobilizations

Immobilizing drug needs were solicited from FWP personnel statewide. New supplies of Telazol, Ketamine Hydrochloride, and Rompun were purchased. Ketamine and Rompun were freeze dried and bottled for use in various projects throughout the state. The computer database with all drug purchases and distribution was updated during the report period. The MDFWP DEA permit was renewed. Consulting was provided to FWP personnel during various immobilization situations throughout the state. Summaries of the statewide drugging and handling form were reviewed and filed. Additional equipment purchases were made to upgrade the laboratory tranquilizing equipment. Outdated drug stocks were incinerated. Two new animal-handling manuals were distributed to the regions. The first was an animal restraint handbook published by the International Wildlife Veterinary Association, and the second was a Manual for Handling Bears. Permission was obtained to reprint fifty copies of the manual, and they were distributed throughout the state. Assistance was provided for the planning of a training program sponsored through MSU which would cover animal handling techniques. Lab personnel instructed two class sessions at a MSU techniques course on animal handling.

Animal Necropsies and Tissue Examinations

A total of 60 specimens representing 17 species of birds and mammals were examined to determine the cause of death or to identify tissues, parasites, or abnormalities. Forty-one necropsies were conducted, and seven tissue samples were

examined by the Veterinary Pathologists at the State Diagnostic Laboratory (Table 2). Three special rabies tests and one assay for strychnine were also submitted. Twelve necropsies were performed at the MDFWP Laboratory. Necropsy reports were filed and distributed to submittors. Seven hair analysis reports were done, and 19 bone marrow compression tests were conducted on mule deer from the Bridger Mountains. X-ray evaluations were performed to assist necropsy and forensic examinations.

Table 2. Species and frequencies of wildlife specimens submitted to the State Diagnostic Laboratory for necropsy and tissue examinations during FY93.

Necropsy Type/Species	Frequency	Percentage
Edible meat/tissue exams	7	14.5
Mule deer	2	4.2
Moose	1	2.1
Bighorn sheep	8	16.7
Mountain lion	10	4.8
Coyote	1	2.1
Bobcat	5	10.4
Elk	1	2.1
Great horned owl	1	2.1
Snowshoe hare	1	2.1
Canada goose	2	4.8
Muskrat	1	2.1
Raccoon	1	2.1
Pheasant	1	2.1
Skunk	2	4.2
Fox	1	2.1
Grizzly bear	2	4.2
Black bear	1	2.1
Total	48	100.0

Annual Trophy Sale

The annual trophy sale was conducted in April. There were 116 items sold including hides, capes, skulls, claws, and antlers from nine species of mammals. Parts from bighorn sheep, black bear, and mountain lion were the most common sale items. Gross sale proceeds were $20,007.50 A total of 86 bidders from throughout the U.S. and Canada registered at the sale.

Educational and Display Materials

The wildlife mounts and reference specimens for local wildlife educational programs were available at the wildlife laboratory throughout the year. Specimens were

checked out by educators 89 times during the report period. Several specimens were loaned to other agencies and institutions engaged in wildlife education programs.

Several educational and display materials were prepared during the year. These include two mounted loons and one sandhill crane. Two buffalo hides were tanned for inclusion in traveling educational boxes. One wolf and one black bear hide were tanned for USFWS educational programs. One whitetail-mule deer hybrid was tanned for a reference specimen.

Forty-five requests for specimens from our hide and skeletal reference collections were received during the year. Thirty-eight requests were filled or partially filled. Thirty-one tanned or green hides were distributed to various institutions, agencies, and museums throughout the U. S. A large request for two grizzly bear hides, and grizzly and black bear skulls and claws was filled to provide educational material to the Grizzly Discovery Center in West Yellowstone. Several green hides of bobcat, black bear, and grizzly bear, were distributed to MDFWP wardens for use in the decoy program. An adult sheep head and one lamb bighorn sheep skin were given to Wyoming for display. A variety of antlers, horns, a sheep head, and grizzly feet were sent to the John G. Shedd Aquarium in Chicago for a wildlife display. A grizzly skull was loaned to MSU for display in the Museum of the Rockies display celebrating MSU's centennial. Various skulls from Montana wildlife were provided to Concordia College Department of Biology. In addition, over 52 skulls from various mammals were distributed to requestors. Requests for jawboards, skeletons, bear claws, antlers, bird study skins, and elk teeth were also filled.

Biotelemetry Frequency Coordination

In 1989, all known users of wildlife biotelemetry in the State of Montana provided information on wildlife transmitters they operated in various programs. The data from this census was entered into a computer database in 1990. A survey was conducted in May 1993 to update the computer database. Updates were made throughout the year as information was received from projects and new frequencies were assigned. A new, thorough update is planned for July 1994.

Frequencies ranged from 148.000 to 171.000 for wildlife telemetry devices. The most commonly used range was 150.000 to 152.000 (Table 3). Approximately 1,207 of the listed telemetry devices were operating on wildlife through the report period. The remainder were on order, in storage, or being rebuilt. Telemetry devices operated on 20 species of wildlife (Table 4). Elk, mule deer, white-tailed deer, moose, and grizzly bear were the most common species radio collared.

Fifteen agencies or institutions participated in the radio telemetry coordination program in 1992-93 (Table 5). The Montana Dept. of Fish, Wildlife and Parks was the agency most commonly employing biotelemetry in their programs.

Table 3. Distribution of radio frequencies used on wildlife telemetry devices, 1992-93.

Frequency Range	No. Transmitters	Percentage
148.000-149.000	149	5.3
149.000-150.000	21	0.7
150.000-151.000	817	29.0
151.000-152.000	1026	36.5
152.000-153.000	192	6.8
153.000-154.000	10	0.4
164.000-165.000	266	9.5
165.000-166.000	242	8.6
166.000-167.000	50	1.8
167.000-168.000	40	1.4
171.000-172.000	1	<0.1
Total	2,814	100.0

Table 4. Biotelemetry devices ordered, stored, or operating on wildlife species in and near Montana, 1992-93.

Species	No. Devices	Percentage
Elk	987	35.1
Deer (WT and MD)	606	21.5
Moose	73	2.6
Grizzly bear	342	12.2
Black bear	49	1.7
River otter	6	0.2
Bald eagle	8	0.3
Mountain goat	38	1.4
Bighorn sheep	62	2.2
Wolf	61	2.2
Golden eagle	1	< 0.1
Caribou	27	1.0
Fisher	51	1.8
Sharptailed grouse	34	1.2
Turkey	99	3.5
Hawk	13	0.5
Pine marten	40	1.4
Mountain lion	73	2.6
Antelope	10	0.4
Unknown or undetermined	234	8.3
Total	2,814	100.0

Table 5. Number of biotelemetry devices used in various wildlife programs within and adjacent to the State of Montana, 1992-93.

Wildlife Agency	No. of Devices	Percentage
The Blackfoot Nation	20	0.7
Confederated Salish Kootenai	14	0.5
U. S. Forest Service *	17	0.6
Mont. Dept. FWP	1,730	61.5
U.S. Fish and Wildlife Serv.	179	6.4
Glacier Natl. Park	23	0.8
Idaho Fish and Game	44	1.6
Interagency Grizzly Study	149	5.3
Montana State University	191	6.8
University of Montana	265	9.4
Wildlife Wildlands Inst.	3	0.1
Wildlife Research Inst.	71	2.5
Yellowstone Natl. Park	75	2.7
Other or Unknown	33	1.1
Total	2,814	100.0

* Includes radio frequency for hand radios.

Parasites of Wildlife

Trichinella tests were completed on black bears, mountain lions, and bobcats, most of which were submitted by hunters. Under a formal agreement with Veterinary Molecular Biology, a program to test black bear harvested by hunters was initiated. Collection packets were assembled and distributed to each MDFWP region to facilitate the testing of black bears for this parasite. A summary report from Veterinary Molecular Biology is presented in Appendix A. During the period, 93 black bears were tested and 12 (12.9%) were positive for trichinella. An informational pamphlet was printed and distributed statewide through MDFWP regional offices and several County Extension Service Offices.

Gastro-intestinal (GI) tracts from ten grizzly bears were submitted for parasitology evaluations. Results were obtained from five and are pending for five specimens. Parasites reported in five GI tracts include *Baylisascaris transfuga*, *Uncinaria* spp., and Nematodes. *Baylisascacris* was found in three of the five GI tracts examined and additionally noted in the post-mortem exam of two cub grizzly bears.

The GI tracts from 12 mountain lions were frozen and stored for future evaluations. Two GI tracts from mountain lions were evaluated for parasites. Parasites identified included Nematodes, Cestodes, *Taenia omissa*, *Taenia* spp., *Toxascaris*

leonina, *Toxocara cati*, *Physaloptera praeputalis*, and *Physaloptera rara*. Over 30 GI tracts have been stored for further evaluations to complement previous work accomplished by Sesee et al. (1991).

Cysts of *Taenia krabbei* were found in five mule deer and two moose. The mule deer came from Park, Madison, Lincoln, Flathead, and Rosebud Counties, while both moose came from Lincoln County.

The giant liver fluke (*Fascioloides magna*) was identified by the Parasitology Laboratory of Veterinary Molecular Biology, MSU, in one moose liver from Flathead County. Three giant liver flukes were found in a mule deer in 1992 (Aune and Schladweiler 1992). This parasite has been rarely identified in wildlife from the Montana region (Worley personal communication)

One bobcat perished from malnutrition presumably precipitated by tapeworm and hookworm parasites.

The parasite *Dracunculus insignis* was identified in a muskrat from eastern Montana.

Nine bighorn sheep deaths were investigated to determine cause of death. Parasites were identified in five of these specimens. Protostrongyles were found to be contributing factors in the death of three of these sheep. Other parasites identified included *Marshallagia* spp., *Eimeria* spp., and *Nematodirus* spp. Results of these investigations are further discussed in the following section on animal disease.

Two moose were found to carry arterial worm (*Elaeophora schneideri*). Both were observed with mild clinical signs of the disease including poor coordination and ataxia. Blindness did not appear to occur in either case. Both moose were shot before the disease progressed fully.

A parasite problem in mule deer was investigated during the year on Cromwell Island, Flathead Lake. There was an apparent parasite problem caused by crowding of mule deer upon the island. Fecal samples collected from the island were examined by Baerman and flotation techniques at the parasitology laboratory at Veterinary Molecular Biology. The discovery of dorsal spine larvae prompted concern to identify that the species of *Parelaphostrongylus* producing the larvae. Further fecal sampling on the Island and the collection of two deer was accomplished with the cooperation of the owner of Cromwell Island. The meninges and muscle tissues were examined in both deer in an attempt to find brain or muscle worms. None were detected. There is no evidence supporting the presence of brain worm in Montana (Aune and Schladweiler 1993). However, further study is recommended to identify the geographic distribution and prevalence of the dorsal spine larvae in mule deer and to identify the species.

Disease of Wildlife

Blood serum samples from several species of wildlife were tested by the Diagnostic Laboratory for the presence of antigen/antibodies against anaplasmosis, bluetongue, brucellosis, and leptospirosis. Additional diseases tested for in some samples included infectious bovine rhinotracheitis (IBR), bovine virus diarrhea (BVD), and parainfluenza 3 (PI_3). Results from these additional tests will provide baseline data for comparison with data collected in subsequent years.

A computer database was updated with entries from serological surveys conducted throughout the state. The database now includes over 7,000 records from many species including deer, sheep, elk, moose, bear, wolf, and lion. Annual file editing and clean-up is complete. Detailed analysis is continuing as time permits and needs arise. The data will be updated annually allowing further analysis of serological survey results.

Surplus serum from various field sources was banked at the laboratory. Several requests for use of this resource were fulfilled. Serum from the Flying D Ranch was submitted to researchers to test for malignant catarrhal fever (MCF) antibodies. Known tuberculosis (TB) negative serum was submitted to the USDA/APHIS TB epidemiologist for research on an ELISA test for TB.

Post-mortem examinations were conducted by the State Diagnostic Laboratory on 41 specimens. Disease processes were identified in 27 of the cases. Canine distemper was diagnosed in one skunk, one raccoon and one coyote during the report period. Parvovirus was diagnosed in one bobcat collected in 1993. Keratoconjunctivitis was found in one mule deer collected from Region 3. Pneumonia was also identified as the cause of mortality in one mule deer, one white-tailed deer, and one moose submitted for post mortem examination.

Nine bighorn sheep carcasses were necropsied during the report period. Seven of these were diagnosed with pneumonia. One sheep died from trauma associated with an automobile accident, and one died from a brain abscess. Various bacteria were isolated in seven cases, and in one a combination of viral and bacterial agents were isolated from the lungs. Lungworm was associated with bacteria in three of the cases. Bacteria isolated included *Pasteurella*, *Streptococcus*, *Staphylococcus*, *Psuedomonas*, and *Moraxella*. The BVD virus was isolated in one case.

One case of pnuemonic plague was identified from an abnormally acting bobcat killed by hunters near Ennis, Montana. *Yersinia pestis* was isolated from the specimen, and the plague diagnosis was later confirmed by the Centers for Disease Control (CDC). This was the second Montana bobcat in two years diagnosed with the plague. The first was a case from southeastern Montana which resulted in the death of one person.

Eight mountain lions were submitted for necropsy. Seven of the eight lions were suffering from various stages of pneumonia. Bacteria isolated from pnuemonic lungs included *Pastuerella haemolytica*, *Staphylococcus* spp., *Streptococcus equisimilis*, *Staphylococcus aureus*, and *Pastuerella multocida*. One case of pneumonia was associated with severe malnutrition, and a second case involved trauma from fractured ribs.

Special Surveillance for Diseases and Parasites in Elk

Recent diagnosis of tuberculosis (*Mycobacterium bovis*) in captive elk near Corwin Springs, Montana, sparked concern for escapement of this disease in wild elk wintering nearby or migrating through the area. In 1990, 22 elk plucks were collected and examined to determine if any wild elk had acquired tuberculosis (Aune and Schladweiler 1991). Prior to the late hunting season in 1991, a tissue collection protocol was established to increase the sampling of wild elk for evidence of tuberculosis. In addition, the protocol allowed collection of data for other diseases and parasites prevalent in the elk herds tested.

In the winters of 1991-92 and 1992-93, three separate elk herd groups were tested for various diseases with an emphasis on brucellosis and tuberculosis. The three sample groups included a group that did not associate with Yellowstone National Park and wintered on the Flying D Ranch (HD311), a segment of the Madison Valley elk herd (HD362) comprised of approximately 50% local elk and 50% elk migrating from Yellowstone National Park, and a sample group that migrated from the northern edge of YNP (HD313) into Montana.

Samples were collected and tested according to methods described previously by Aune and Schladweiler (1992). Some preliminary results were summarized for preparation of a presentation to the U.S. Animal Health Association in October 1993. This effort was conducted in cooperation with the western region TB epidemiologist for USDA and researchers from Colorado and Wyoming. The full manuscript is provided for the reader in Appendix B.

One positive brucellosis culture was found in the sample of 251 elk (Table 6). *Pasturella multocida* was cultured from 15.8 percent (N=210) of the elk. Lungworm larvae were found in 11.8% of the elk fecal samples (N=194) tested. Subtle differences may exist in the prevalence of brucellosis and lungworm between the various herd groups. Further detailed analysis is planned for the final publishing of the data from this study.

Hemorrhagic Disease Survey

The wildlife lab coordinated Montana's participation in the annual nationwide hemorrhagic disease surveillance conducted by the Southeastern Cooperative Wildlife

Table 6. Results from disease surveillance conducted on elk in Montana from 1991-93. Results presented as the culture or sero-positive samples over the total sample.

Location/Year		Brucella abortus serology*	Brucella abortus culture	Pastuerella multocida culture	Mycobacterium paratuberculosis culture	Dictyocaulis exam	Actinomyces-like lesions	Number of Animals Sampled
Flying D	91-92	0/30 (0/88)	0/29	10/23	0/25	3/24	7	33
	92-93	0/20 (0/124)	0/21	3/16	In Progress	2/19	4	22
	Total	0/50 (0/212)	0/50	13/39		5/43	11	55
Madison	91-92	1/18 (3/184)	1/17	3/36	0/18	0/18	1	40
	92-93	0/46 (0/156)	0/46	0/12	In Progress	-	5	46
	Total	1/64 (3/340)	1/63	3/48		0/18	6	86
Gardiner	91-92	2/143 (8/719)	0/138	17/123	0/139	18/133	12	151

* Numbers in parenthesis include blood collected by hunters as well as blood collected during tissue sampling.

Disease Study. Fifty-eight questionnaires were sent to field biologists and wardens located in areas where hemorrhagic disease might be expected to occur. Two of the 20 responses indicated probable outbreaks of the disease. These involved 17 mule deer in Powder River County and one antelope in Dawson County. This represents a mild year in terms of extent of the disease and the number of affected animals.

Plague and Distemper Surveillance

During the winter of 1992-93 a special surveillance for plague and distemper was conducted in north-central Montana. The surveillance report is presented in Appendix C. Surveillance for this area is proposed for the winter of 93-94.

Grizzly and Black Bear Studies

Morphology Studies

Two databases were created in 1991 to examine the morphology of grizzly and black bears in Montana. The mortality database includes all deaths plus results from examination of bear carcasses. This database was updated with records from over 652 black bears and 1,019 grizzly bears. The black bear capture database includes data from over 900 black bears handled during research throughout Montana. The grizzly bear capture database includes records of 297 grizzly bears handled in the northwestern portion of Montana.

Measurements of grizzly bear skeletons collected over 30 years is complete. The information is going through format conversions and will be analyzed in the near future as time permits. Collection and measurement of skulls will also be continued as time allows. Results were not summarized as expected. The project will continue as time permits.

Nuisance Bear and Relocation Study

In the Northern Continental Divide (NCDE) and Yellowstone (YES) Ecosystems, records of relocations were compiled from capture forms provided by field personnel. In addition, summary data collected by the endangered species biologist for use in the Grizzly Bear Programmatic EIS was reviewed for development of a complete record of problem bear activities in Montana. Data are presented here for the calendar year rather than MDFWP fiscal year because of the annual cycle of bear activity. A database was created at the laboratory to record all problem incidents in Montana. This will be updated annually in cooperation with the state endangered species biologist.

To accurately measure annual variation in these activities, several definitions were developed. A relocation included movements within a bear home range as well as far outside. However, movements within home ranges (short distance) are indicated in the

record. A problem case was the situation leading to control actions. Relocations include each individual relocation (e.g. if mother and cubs are split up, the relocations are independent). A problem incident is a reported situation which demands attention or is a significant interaction between bear and humans or their property or livestock.

In the NCDE during 1993, three bears were relocated as a result of three problem incidents. One bear was eventually destroyed after it returned and caused further problems. One relocation effort occurred in May, one in August, and one in October.

Comparisons from 1988 to date show a significant amount of variation in these activities from year to year (Table 7). These variations are probably a result of short-term environmental changes which can be natural or human caused (e.g. drought, food failures, corn spills, etc.). A significant amount of relocation activity occurs both east and west of the Continental Divide. Most of the relocation activity is oriented toward females by management direction, therefore the ratio of females/males over time will be skewed. Males involved in problems are more readily removed from the ecosystem. A complete analysis of the success of relocation efforts in the NCDE was presented at the IBA conference (Riley et al. in press).

Records from the Animal Plant and Health Inspection Service, Animal Damage Control Division (APHIS/ADC) are filed at the laboratory annually. Statewide APHIS/ADC grizzly bear control activities from 1967-1993 were summarized to determine trends in these activities (Fig. 1). The number of control actions varied from year to year. However, trend lines indicate that the actions have been stable to slightly increasing for this time period. Control kills have been reduced in recent years because many bears were relocated rather than destroyed. A notable decline in control actions is evident for the early 1970s until 1975. The number of livestock conflicts with grizzly bears has risen since the early 1970s.

Table 7. Updated summary of grizzly bear relocations in the Northern Continental Divide Ecosystem during 1988-1993.

Year	No. Bears	No. Cases/ Relocations	Sex Ratio	No. Killed That Year	No. on East/West
1988	3	3/3	1M/2F	1	3E/0W
1989	15	10/12	6M/9F	2	6E/4W
1990	9	9/9	3M/6F	1	3E/6W
1991	12	13/14	8M/4F	2	8E/5W
1992	9	8/9	3M/6F	2	1E/7W
1993	3	3/3	2M/1F	1	1E/2W
Total	51	46/50	23M/28F	9	22E/24W

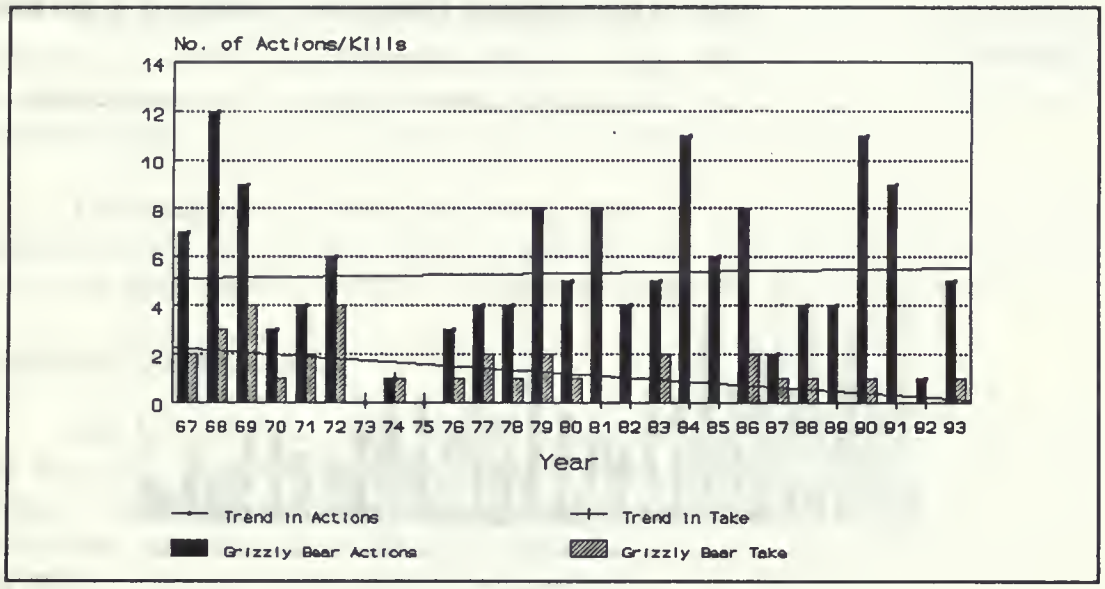


Figure 1. APHIS/ADC animal damage control activities in Montana, 1967-93

Grizzly Mortality Study

The master database was updated for all known grizzly bear mortalities for the Northern Continental Divide Ecosystem. Data in the files are being verified at this time for more complete summarization. Results presented below may be modified slightly to correct errors identified in the validation process. Grizzly mortalities in the Yellowstone Ecosystem back to 1959 were updated and were all validated through comparison with previous efforts by Craighead et al. (1988) and Knight et al. (1993).

For the period 1967-1993, a total of 489 grizzly bear deaths or live removals were recorded in the NCDE. The data were summarized by region in a test of the information base. In MDFWP Regions 1, 2, and 4, a total of 357, 28, and 104 bears, respectively, have been removed. Mortality has varied annually but has been generally declining (Fig. 2). The sex ratio of the pooled mortalities or live removals is 45.4% female and 54.6% male. More males than females have been removed from the population in all regions (Fig. 3). Region 4 had the largest proportion of males removed.

For the period 1959-1993, a total of 517 known grizzly bear deaths or live removals were recorded in the Yellowstone Ecosystem. Population loss varied annually but has generally been declining (Fig. 2). The sex ratio for all mortalities or removals was 42.7% female and 57.3% male. There were 125 and 8 grizzly bears (25.7% of total) removed from the population from Regions 3 and 5 within the administrative jurisdictions of MDFWP. About one-third of the grizzlies removed from the ecosystem (37.7%, N=195) came from within the boundaries of Yellowstone National Park. There

were 189 grizzlies (36.6%) removed from National Forests and private land in the states of Wyoming and Idaho.

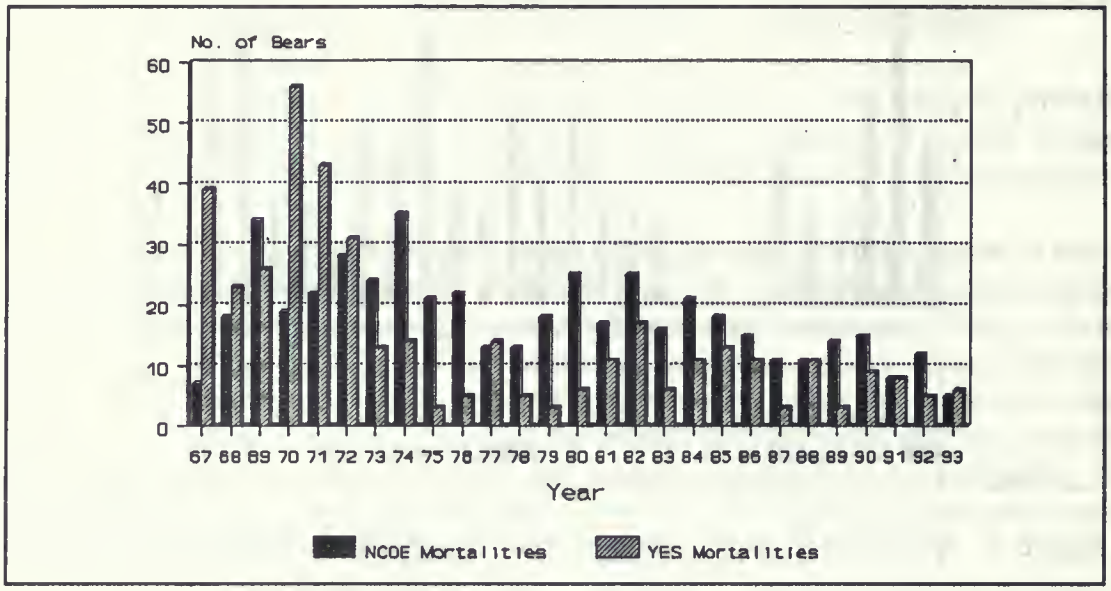


Figure 2. The number of grizzlies removed from the NCDE and YES annually, 1967-1993.

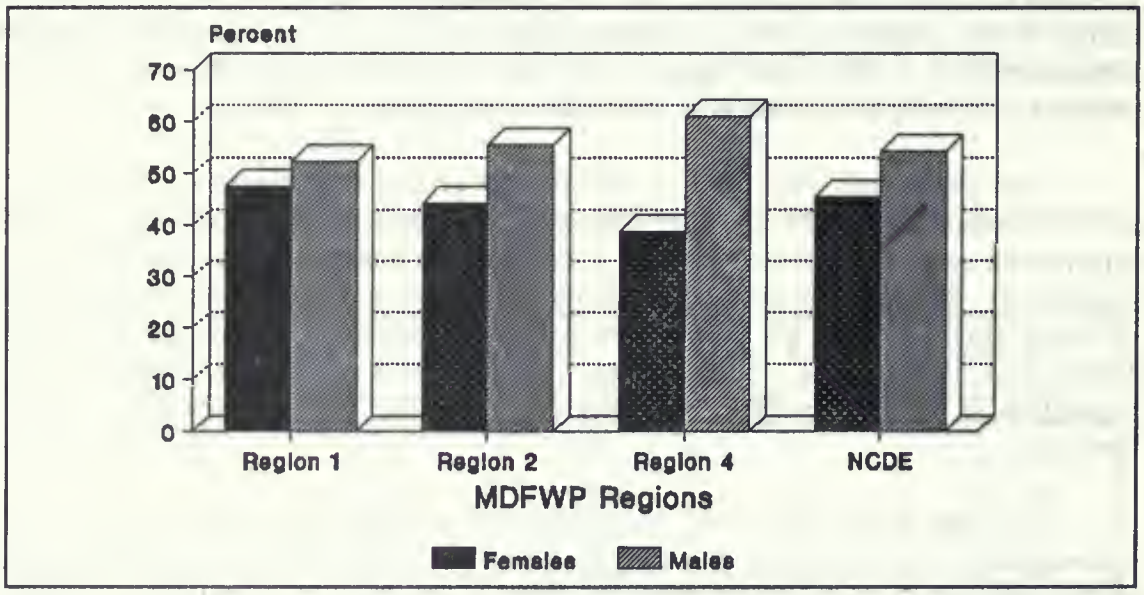


Figure 3. Grizzly bear removals by MDFWP Region for the NCDE, 1967-1993.

When comparing the number of mortalities in each month for the NCDE and YES there are some observable differences (Fig. 4). In the YES there was a higher incidence of mortality grouped into the summer months. In the NCDE most of the mortality occurred during the fall when annual hunting seasons were held until 1990.

The age distribution for grizzly bears removed from the NCDE and YES differed slightly (Fig. 5). There were more young-aged bears (2-6) killed in the NCDE while more cubs were removed from the Yellowstone Ecosystem for this time period.

Black Bear Mortality Study

During the period 1986-1993, the annual non-hunting mortality for black bears was recorded. Non-hunting mortalities include illegally taken bears, roadkills, animal damage control, and nuisance bears. These records do not represent all non-hunting mortalities, but only those for which a hide, skull, or carcass was submitted to the laboratory. During 1986-93, the annual non-hunting loss of black bears reported at the laboratory has ranged from 20-47 (Fig. 6). The apparent increase after 1988 results primarily from increased attempts to account for non-hunting mortalities statewide. Work is proposed to improve the reporting of non-hunting mortality in Montana. Detailed report forms and accurate regional accounting of black bear mortalities statewide are recommended in the future.

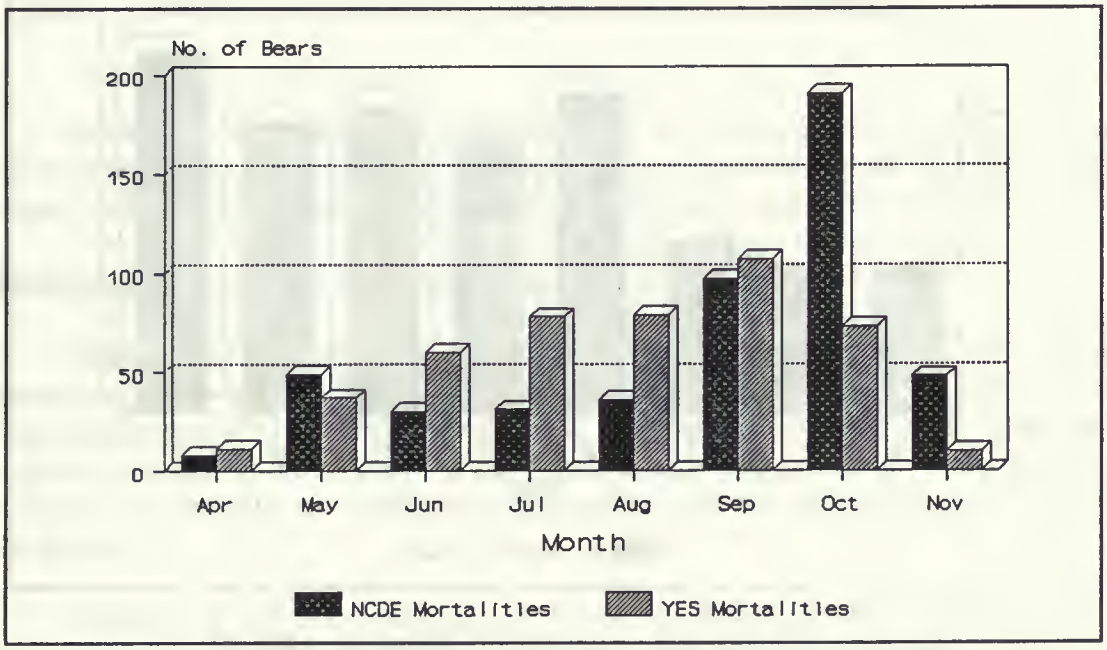


Figure 4. Grizzly mortalities by month for the NCDE and YES, 1967-93.

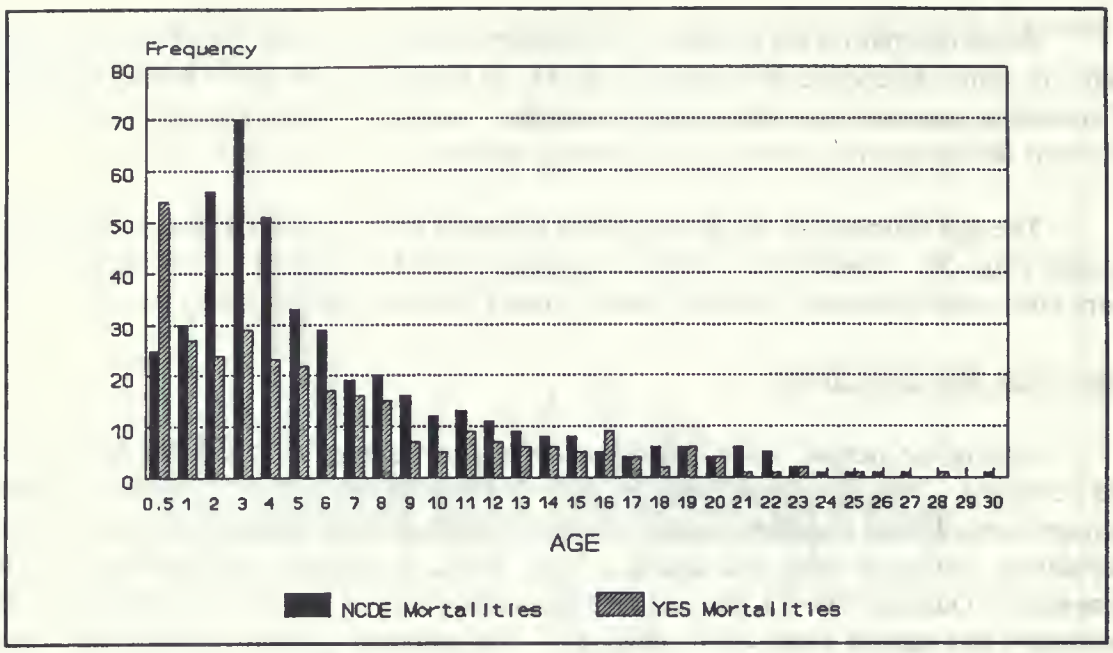


Figure 5. Ages of grizzly bears killed in the NCDE and YES, 1967-93.

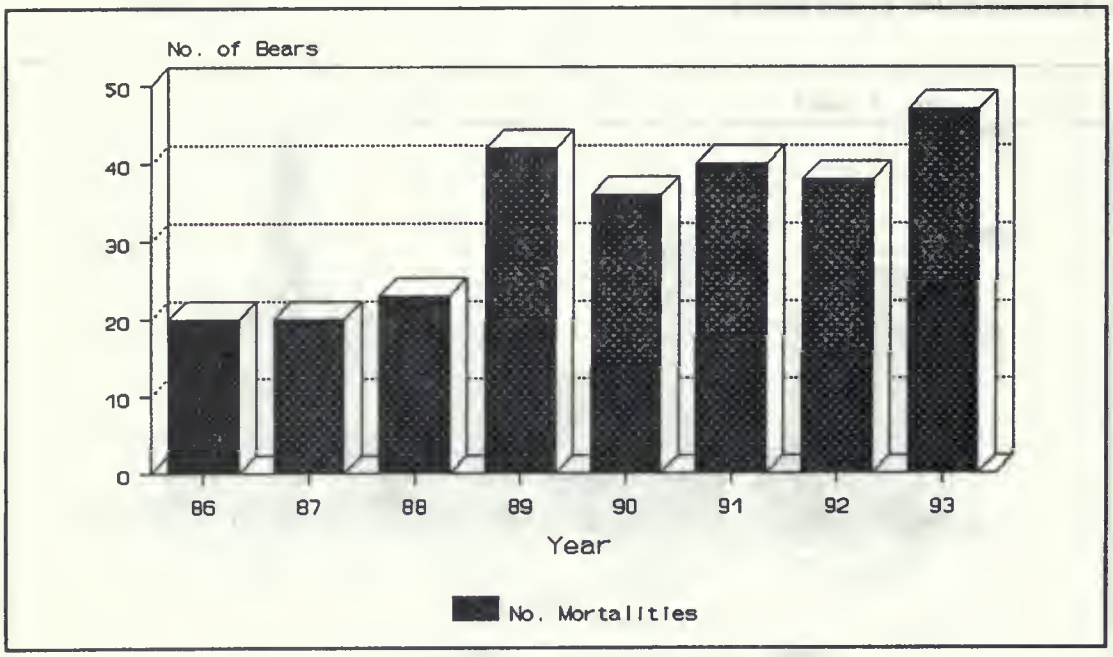


Figure 6. Non-hunting black bear mortalities in Montana, 1986-93.

Non-hunting black bear mortality was recorded between March and December (Fig. 7). Statewide, the majority of non-hunting mortalities occur during the spring and fall months. September was the month with the highest percentage of non-hunting black bear mortalities.

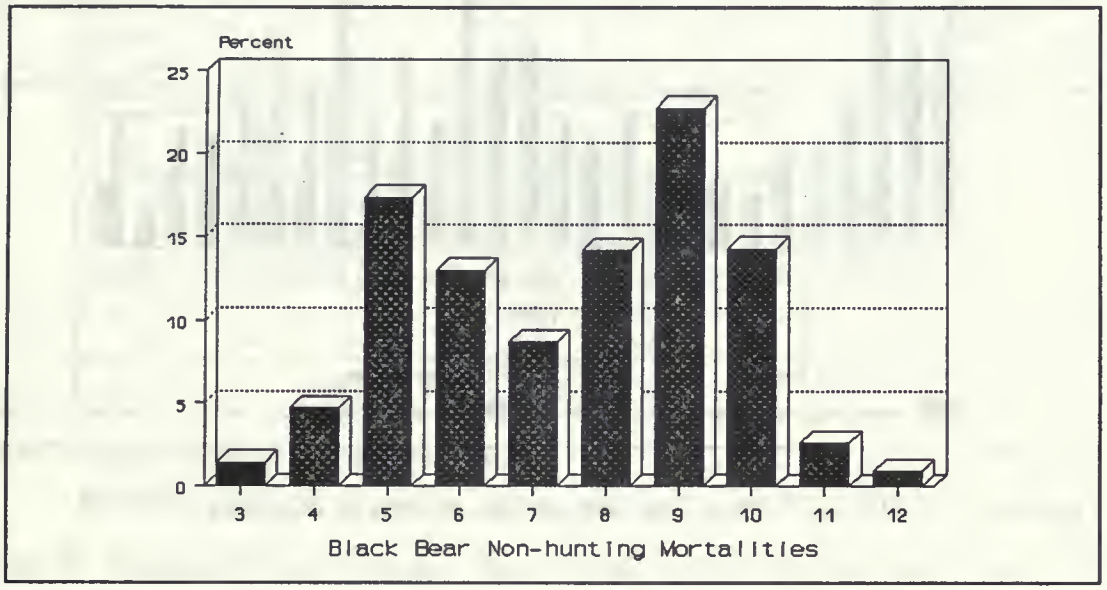


Figure 7. Non-hunting black bear mortalities by month, 1986-93

Black bear animal damage control activities vary annually (Fig. 8). Recent years indicate a decreased level of activity directed toward black bears by APHIS/ADC. Most of these problems have been related to sheep depredations and beehive damage.

Disposition of 1993 Grizzly Bear Carcasses

Grizzly bear mortalities in 1993 totaled five for the Yellowstone, one for the Cabinets, and six for the NCDE. Three Yellowstone carcasses were recovered by Wyoming Game and Fish. Two mortalities in the Montana portion of the Yellowstone Ecosystem resulted in the recovery of one whole carcass and one skull. Both skulls and one hide are presently in MDFWP Laboratory specimen collections waiting final disposition.

One carcass was retrieved from the Cabinet Ecosystem. Only the claws and skull were salvageable. Following detailed necropsy, the skull was cleaned and returned to USFWS in Libby, Montana.

In the NCDE, two grizzly hides and skulls were retained for the Blackfeet Nation where the specimens originated. One grizzly mortality was a live removal to a zoo. For

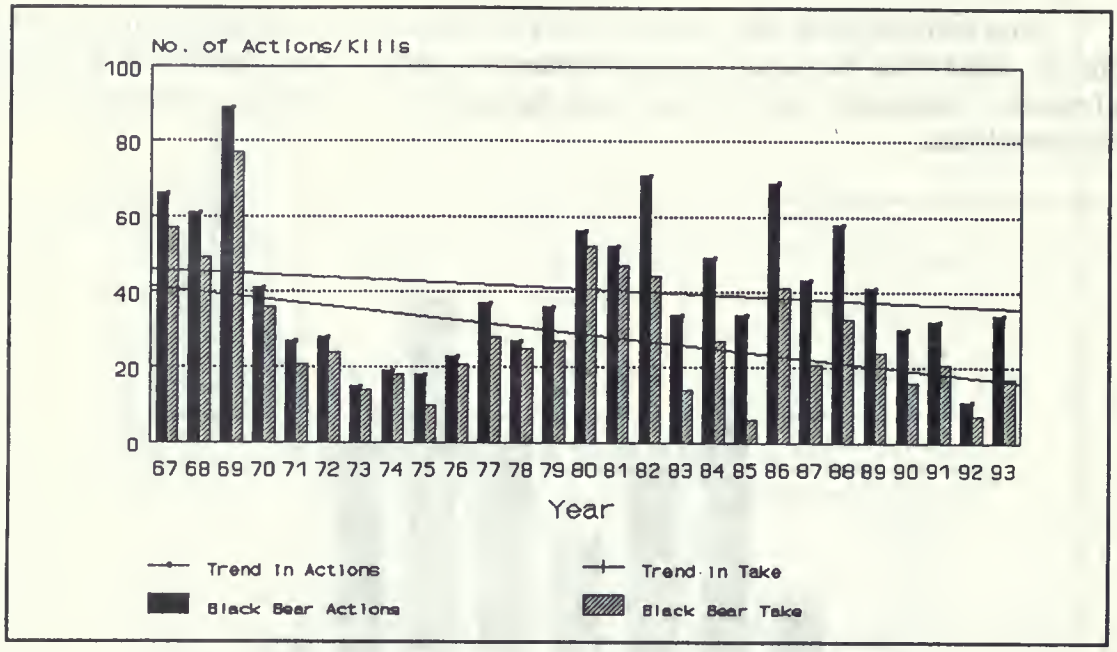


Figure 8. APHIS/ADC black bear depredation actions in Montana, 1967-93.

two mortalities, only the skull and some bones were retrieved. One complete carcass resulted in the collection of a hide and skull. Both are at the MDFWP laboratory awaiting final disposition.

Gallatin Black Bear Study

In 1992, a spring photo-survey was conducted in two areas including the Turner Properties Flying D Ranch and a portion of the Gallatin Forest between Bozeman and Swan Creek. The study area south of Bozeman represents a forested black bear habitat with high human disturbance and roading. The 132,698 acre Flying D Ranch is adjacent to the Spanish Peaks Wilderness with habitat similar to the area south of Bozeman but with lowered human impacts and roading. Hunting pressure between these two areas is undoubtedly different.

Seven camera stations were placed along two transects across each study area and were operational for 10-20 days during June. Bears tallied included single bears and family groups. Family groups were counted as an individual bear unit because cubs are unable to act independently.

There was little difference apparent in the black bear detection rate (camera nights/individual bear) between the area South of Bozeman and the Flying D Ranch (Table 8 and Table 9). Black bear were detected at 5 of 7 stations on the Flying D Ranch and at 2 of 7 stations in the area south of Bozeman. Black bears were detected

in 23.7 and 29.1% of the total photographs taken on the Flying D Ranch and South of Bozeman, respectively.

Table 8. Results from photo-census efforts on the Turner Ranch, June 1992.

Site	Camera Nights	Total Photos	Bear	Elk	Deer	Moose	Errors	Test	Ind. Bears	Ind. Moose
1	20	40	9	4	11	4	3	9	2	1
2	20	19	4	0	2	0	6	7	1	0
3	20	75	0	0	8	14	47	6	0	2
4	17	98	47	0	0	2	35	14	4	1
5	7	109	24	4	18	11	41	11	1	1
6	18	94	37	8	3	4	32	10	2	2
7	2	75	0	27	0	0	44	4	0	0
Total	104	510	121	43	42	35	208	61	10	7
	10.4 *		23.7%	8.4%	8.2%	6.9%	40.8%	12.0%		

* Rate = Camera Nights per individual black bear unit

Table 9. Results from photo-census efforts on the Gallatin National Forest, June, 1993.

Site	Camera Nights	Total Photos	Bear	Elk	Deer	Moose	Errors	Test	Ind. Bears	Ind. Moose
1	10	26	0	0	3	5	2	16	0	1
2	10	36	27	0	0	1	3	3	4-5	1
3	10	11	0	0	1	2	4	4	0	2
4	9	13	0	0	0	3	2	8	0	1
5	9	18	0	2	4	0	7	5	0	0
6	9	5	0	0	0	0	1	4	0	0
7	9	39	16	0	6	4	2	9	2	1
Total	66	148	43	2	14	15	49	49	6-7	6
	9.4-11.0 *		29.1%	1.4%	9.5%	10.1%	33.1%	12.0%		

* Rate = Camera Nights per individual black bear unit

Ten individual bears were identified from photographs on the Flying D Ranch. There were 6 or 7 individual bears identified in the camera census for the area south of Bozeman. One bear identification could have been duplicated from another station during the latter survey.

Other animals detected included moose, elk, white-tailed deer, mule deer, coyote, mountain lion, and various birds. Fewer elk but slightly more moose were detected in the area south of Bozeman when compared to the Flying D Ranch.

In 1993, four camera stations were deployed from May 28 until October 19 on the Flying D Ranch. The stations were maintained weekly. The objective was to monitor black bear visits and to attract black bears to facilitate collecting scat samples for chemical analysis and identification of food habits.

The black bear detection rate for June 1993 was similar to the detection rate for June 1992 on both the Flying D Ranch and the area south of Bozeman (Table 10, Fig. 9). The percentage of black bear photographs taken was lower while the percentage of errors increased. There were 20 individual bear visits during the period.

Table 10. Results from photo-census efforts on the Turner Ranch, June through October 1993.

Site	Camera Nights	Total Photos	Bear	Elk	Deer	Moose	Errors	Test	Ind. Bears	Ind. Moose
1	68	254	19	21	24	0	147	43	5	0
2	117	196	40	8	16	27	54	51	3-4	5
3	96	241	47	21	3	15	110	43	3	2
4	94	249	32	19	7	1	113	45	5-6	1
Total	375	940	138	69	50	43	424	182	15-18	8
	25.0-20.8 *		14.7%	7.4%	5.3%	4.6%	45.2%	19.4%		

* Rate = Camera Nights per individual black bear unit - June only rate=12.0

Detection rate, as measured by camera nights per bear detection, was best during June and poorest during October (Fig. 10). Measurements of detection rates were not made for the months of April or May.

Preliminary results suggest that camera-survey techniques may be useful in monitoring relative abundance and evaluating distributions of black bear populations. Detailed techniques and analytical methods need to be developed before such systems can be applied broadly to other areas or species. Results from survey work on the Flying D indicate that spring is the most efficient period for detecting black bears. Low detection rates in other months may be related to reduced effectiveness of baits and other attractants, increased mobility of black bears, and increased attractiveness of natural foods such as wild fruits and pine nuts. Operation of the cameras during the heat of summer and early fall increased the number of system malfunctions at many stations.

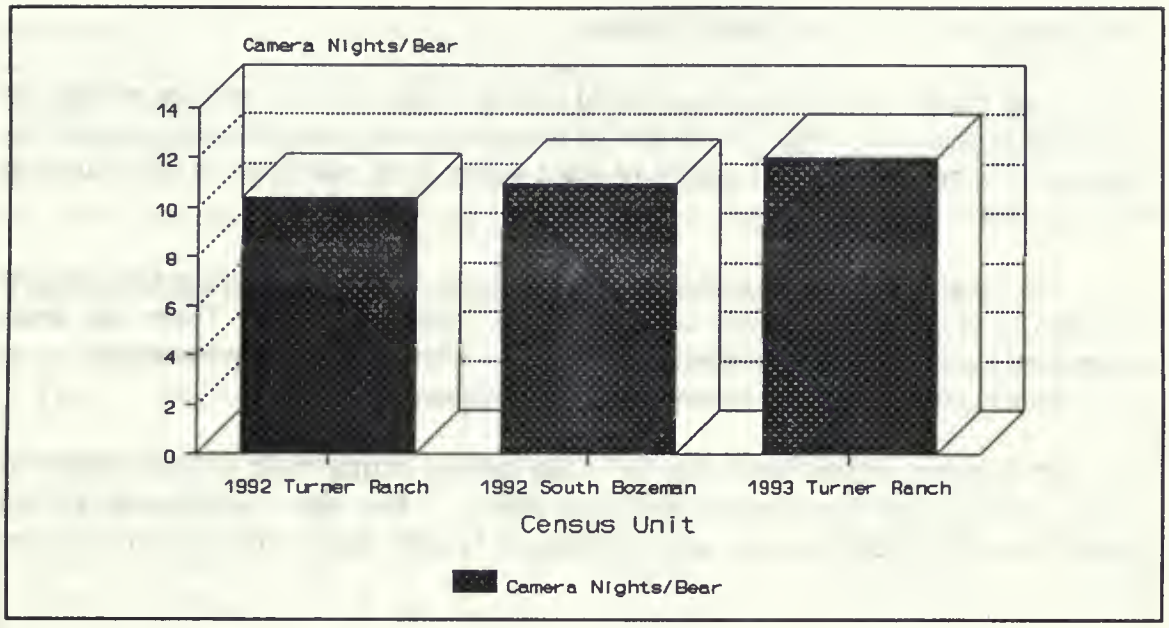


Figure 9. Camera nights per bear detected during Jone on two Gallatin Canyon study areas.

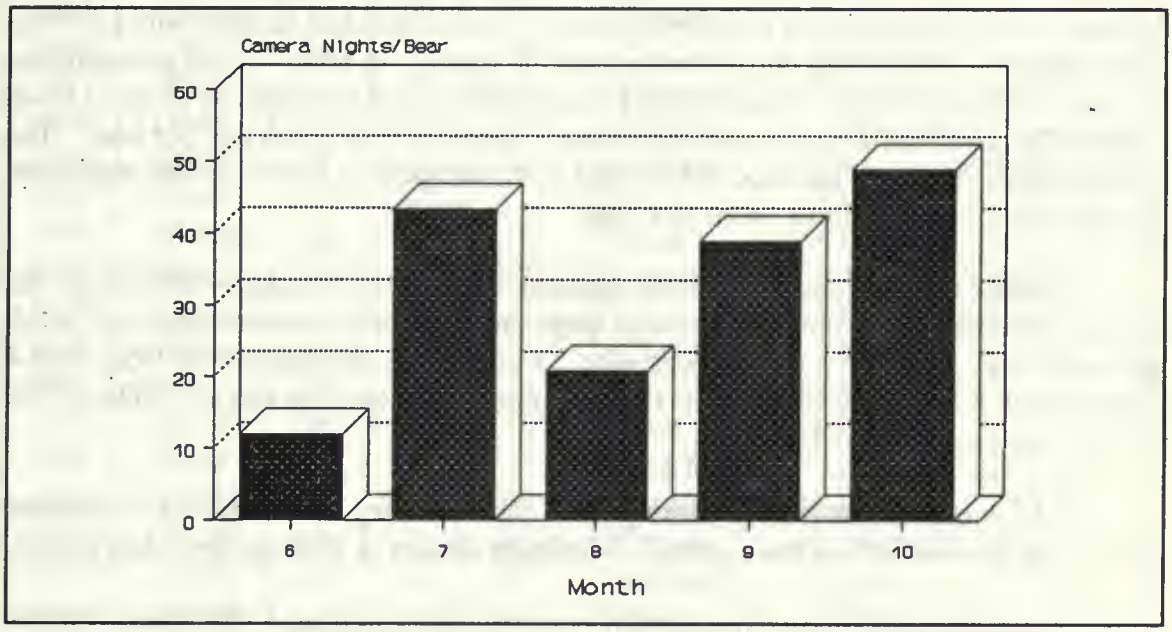


Figure 10. Black bear camera detection rates by month on the Turner Ranch, 1993.

Black Bear Food Habits and Fecal Nitrogen

Fifty black bear scats were collected during weekly visits to camera stations on the Flying D Ranch in 1993. Forty-four of these scats contained primarily vegetation. These scats were dried, and 10 grams of dried matter were submitted to fecal nitrogen analysis. Results are pending.

Fifty scats are being analyzed for food content. Preliminary results indicate that important food categories include carrion, berries, grass, and forbs. There was some evidence of possible elk calf predation in one scat. Clover was a very commonly eaten forb. Detailed results will be presented at a later date.

Phenologic records were kept by video camera during visits to each station to grossly evaluate plant development at camera stations. This year was characterized by arrested phenologic development and a prolonged "green" season for most grasses and forbs.

Black Bear Populations

Examination of all photographs from the Flying D Ranch in 1993 indicated between 15 and 18 bears present on approximately 168 square miles of black bear habitat. This represents a very minimum count. When individual females with cubs that were observed in the field but did not appear in photos are added to the photographic survey results, the number of individually recognizable bears increased to 21 or 24 black bears. These represent a minimum population density of 7.0 or 8.0 mi^2 per bear. The field methods employed are expected to yield minimum density values; actual population density could be as much as twice this high.

During the 1992 and 1993 field seasons, sightings of females with cubs on the Flying D Ranch were obtained through photo-surveys or by observations by ranch personnel and MDFWP. Six females with 13 cubs were enumerated in 1992, and 4 females with 8 cubs were censused in 1993. Average cub litter size was 2.1 (SD=0.739, N=10) and ranged from 1 to 3.

The two-year summary of females with cubs indicates a minimum of 10 females present on the area for the study period. Minimum density is 16.8 mi^2 per adult female.

Field data and reports from ranch personnel both indicated that fewer females with cubs were present in 1993 than in 1992.

Wolf Mortality Study

A formal wolf mortality recording process is currently under development in Montana. A short summary of wolf mortality reports received by our laboratory was

developed in 1989 to begin formalizing the process. Old records in the laboratory files were examined to determine when and where wolves were killed in Montana in recent history (Table 11). Several specimens were processed through the laboratory before a lab protocol was established. The record may be incomplete for these specimens. At this time, the list is fairly complete but may be missing records of mortalities recorded by other agencies but not processed or reported to the laboratory.

Table 11. Wolf mortalities recorded through the MDFWP laboratory, 1956-93.

Year	Lab No.	Sex	Age	Weight (lbs.)	Specimen	Cause of Death
1956	None	M	Ad.	86	Whole	Mistaken ID
1974	177049	F	5	--	Skull	Natural (skull found)
1977	177442	F	-	--	Skull	Unknown
1978	177740	F	Ad.	83	Carcass	Fatal Gun Shot
1981	178620	M	Ad.	110	Carcass	Animal Control
1987	179649	M	4	101	Carcass	Animal Control
1987	179656	F	Pup	39	Carcass	Animal Control
1987	179657	M	Pup	58	Carcass	Animal Control
1987	179659	F	4	--	Carcass	Trapped
1988	179737	M	3	64	Carcass	Roadkill
1989	179878	M	2	107	Carcass	Animal Control
1989	179920	F	Pup	27	Carcass	Relocation/Starvation
1989	179921	F	Pup	30	Carcass	Relocation/Starvation
1989	None	M	Ad.	--		Illegal
1989	179946	M	2	--	Skull	Unknown (B.C.)
1990	180044	F	1	62	Carcass	Animal Control
1990	None	F	Ad.	--		Relocated/Illegal
1990	None	M	Ad.	--	Carcass	Roadkill
1991	None	F	Ad.	--		Illegal
1991	180237	M	Pup	--	Skull	Natural
1991	None	F	1	--	Live Removal	Animal Control
1991	180255	M	1	96	Carcass	Illegal
1991	180256	F	1	80	Carcass	Animal Control
1992	180389	M	3	54	Carcass	Natural
1992	180488	-	-	--	Skull	Unknown
1993	None	M	?	--	To Ashland	Illegal
1993	None	?	?	--	To Ashland	Natural
1993	None	M	2	--	To Ashland	Illegal
1993	180792	F	?	--	Carcass	Natural
1993	180788	F	Pup	70	Carcass	Train

Thirty wolf mortalities have been reported to MDFWP during the period 1956-December 1993. Most (25) died since 1987 when wolf pack activity began in northwest Montana. Much of the mortality has included wolf pups, yearlings, and 2-year olds. Five mortalities (16.7%) were from natural causes, 22 (73.3%) were man caused, and the cause of death was undetermined for 3 (10.0%) wolves.

The earliest mortality records came from northeastern Montana while the later records come from northcentral and northwestern Montana. All records come from near the Canadian Border with the exception of a roadkill near Yellowstone National Park. Necropsy results of the latter animal indicated that it may have recently escaped or been released from captivity.

Mountain Lion Studies

Montana mountain lion studies included examination of previous laboratory records, 70 whole carcasses, and over 350 skulls from hunter-killed lions. A standard laboratory protocol was established for each lion skull and carcass examined. Age and sex were determined from each skull. Each carcass was measured, reproductive tracts and fetuses were collected, stomach contents analyzed, and general condition indexes developed. Many diseased or parasitized lions were examined to quantify the extent of these conditions.

Mountain Lion Morphology Study

Skulls from hunter-killed mountain lions were measured. Analysis was not completed by the time of this report. The reader is referred to previous laboratory reports for review of earlier efforts in this area of study.

Physical measurements and weights are taken from each specimen processed in the Wildlife Lab. The final analysis is awaiting final age determinations of each specimen using multiple age techniques. It is paramount that age be accurately determined before analysis. We anticipate a complete summary of the physical characteristics of Montana mountain lion in the next annual report.

Mountain Lion Reproduction

Since 1989, over 70 female reproductive tracts have been collected and fixed for detailed examination at a later date. Work is now progressing on these specimens. In addition, efforts have been made to collect fetuses from all pregnant female lions. These are weighed and measured to develop a fetal growth chart which will help in defining conception dates for pregnant lions collected in the future. Eighteen fetuses have been collected from five litters (an average of 3.6 fetuses per litter), and 14 were measured. Fetuses grew from a weight of less than 1 gram to a birth weight of over 500 grams.

Further work is planned for detailing the reproductive activity of mountain lions from carcass collections, and results will be presented at a later date.

Age Determinations of Lions

Lions were aged by cementum annuli counts (Trainer and Matson 1988) and analysis of skull sutures (Greer unpublished data). Cementum annuli counts were checked against 23 known aged lions in our sample (Table 12). Some discrepancies were noted, especially in lions older than 2 years of age. Skull measurements obtained for each lion indicated that in general, length and width were incrementally larger with increasing premolar tooth age. In addition, age distributions from 1988-92 followed the expected pattern suggesting that these ages may be valid. Each year, we receive additional known-aged lions, and the number of lions older than 2 years has been increasing. Further testing is needed to determine the accuracy of premolar cementum annuli counts for aging mountain lions.

All lion skulls processed in 1992-93 were also x-rayed. The radiographs showed that the canine pulp cavity and those from other teeth may prove to be reliable indicators of age. Canine tooth pulp cavities were measured on all known-aged lion radiographs, and results are being analyzed to determine the proper criteria for classifying lions. Radiographs are used as an accessory age technique for lions in the 10 month to 2-year old class. Further work is planned, and a summary of results will be presented in the next annual report.

Mountain Lion Food Habits

Stomach contents from 56 mountain lions were reported by Aune and Schladweiler (1992). Contents from 19 additional stomachs were collected in 1993. Contents from 14 lion stomachs involved in livestock or human conflicts are presented in the section on human/lion interaction. Results from the remaining five lion stomachs are pending. Analysis to this date indicates a varied diet consisting of elk, white-tailed deer, mule deer, moose, small mammals, and other miscellaneous items. The number one food item for lions was white-tailed deer followed by elk and mule deer. Detailed analysis is being deferred until further collections have been made.

Lion Mortality Study

The mountain lion harvest has increased significantly and steadily from 50 lions in 1970-71 to over 350 in 1992-93 (Fig. 11). The harvest increase correlates with increased license sales during this period (Fig. 12). Harvest quotas and female subquotas were instituted statewide for the 1987-88 hunting season. Quotas have become more liberal in recent years, adding to the increased harvest.

Table 12. Comparison of known aged lions with cementum annuli counts, canine pulp cavity ratios, and suture class determinations.

Lab No.	Known Age	Suture Class	Percent Pulp Cavity	Cementum Annuli	Sex
180435	4-6 mo.	KI		0A	M
180373	6-8 mo.	KI		0A	M
180380	6-8 mo.	KI		0A	F
180229	6-8 mo.	KI		-	M
180219	6-8 mo.	KI		0A	M
180411	6-8 mo.	KI		-	M
180413	6-8 mo.	KI		-	F
5660	8-10 mo.	KI		0A	M
180462	8-10 mo.	KI	86.7	0B	M
5688	8-10 mo.	KI		1B	M
5130	10-12 mo.	I		2A	F
5711	10-12 mo.	I		2B	M
5444	10-12 mo.	I		1A	M
180296	10-12 mo.	I	76.0	1A	?
180463	10-12 mo	I	71.4	-	F
180464	10-12 mo.	I	71.4	1B	F
180299	10-12 mo.	I	76.9	2B	F
180456	12-14 mo.	I	66.7	3B	M
180352	17 mo.	I	53.3	4A	F
180370	17-18 mo.	I	50.0	-	F
4651	18 mo.	II		2B	M
180384	19 mo.	II	42.9	3A	M
6702	30 mo.	II	35.3	6B	M
5592	30 mo.	II	27.8	11A	M
6704	30 mo.	II	23.5	11B	M
3348	3 yr.	III		7B	M
3353	6 yr.	VI		8B	F
4182	7-8 yr.	VII		5B	F

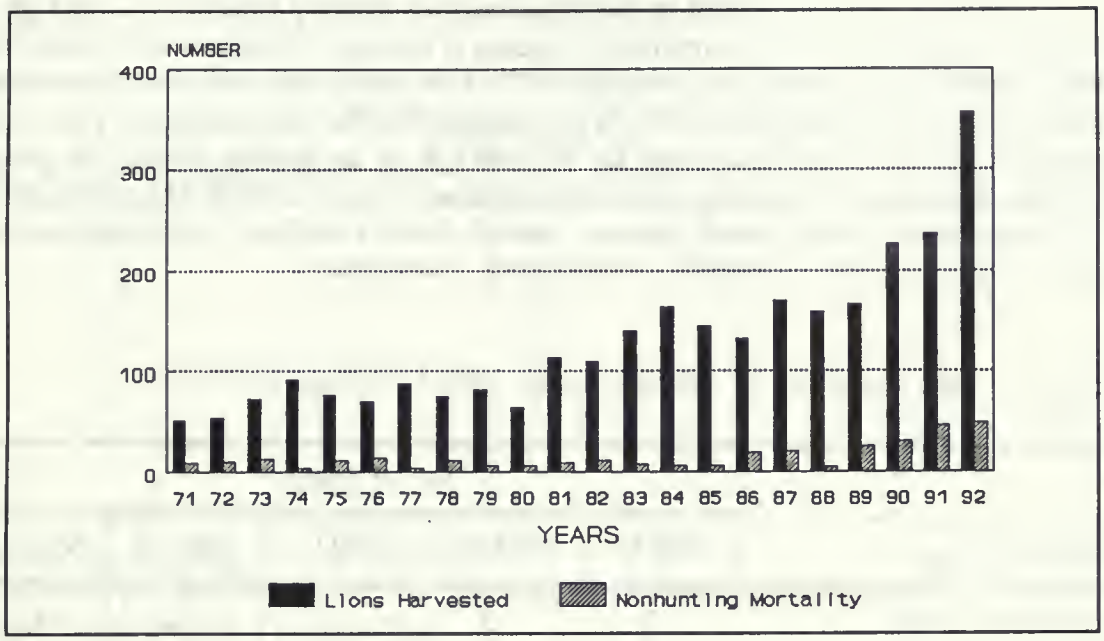


Figure 11. Mountain lion mortality trend, 1971-92.

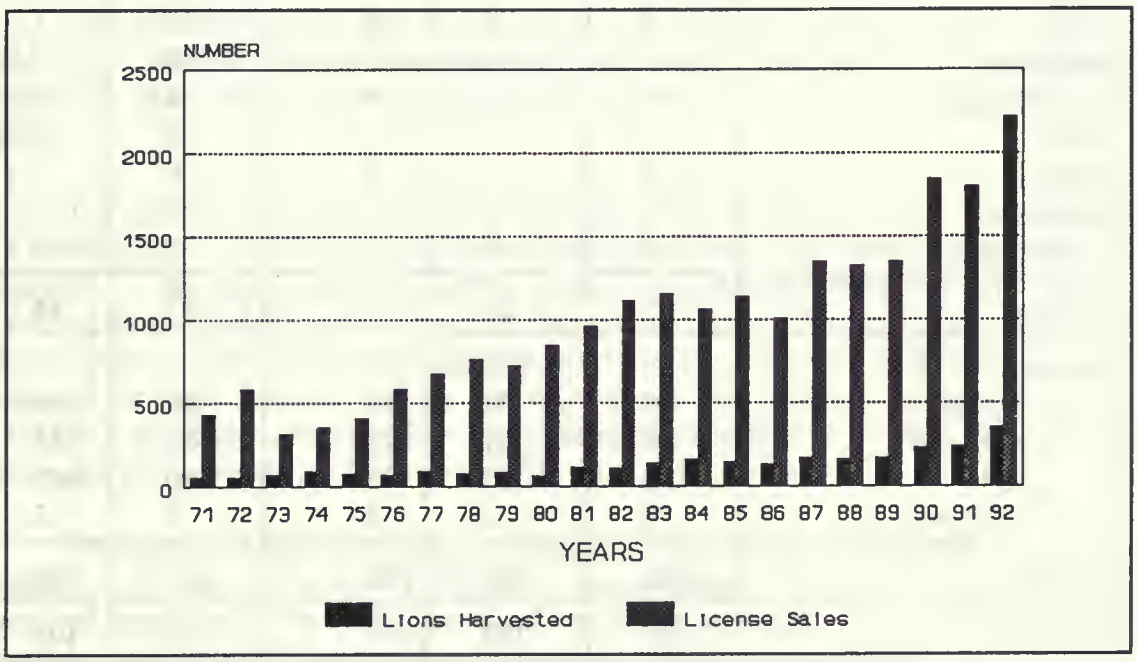


Figure 12. Lion harvest and license sales from 1971-72 through 1992-93.

The mountain lion harvest in Montana has risen steadily from 159 in 1988-89 to 356 in 1992-93 (Table 13). A significant increase in hunting mortalities occurred during 1990-91 and 1992-93 (Fig. 11). Regions 1, 2, 3, 4, and 5 reported similar or higher numbers of hunter kills during 1992-93 as compared to the previous year (Table 14). Regions 1 and 2 together accounted for 62.9-69.6% of the harvest during the period 1988-93. Recorded non-hunting mortalities increased from 5 in 1988-89 to 48 in 1992-93. Self-defense cases, animal damage control, vehicle collision, and nuisance lion control actions accounted for 60% of nonhunting mortalities.

Table 13. Lion mortalities by mortality class, 1988-89 through 1992-93.

Mortality Class	No. of Lions *				
	1988-89	1989-90	1990-91	1991-92	1992-93
Accidental Snare	2	3	1	2	4
Animal Damage Control	0	4	7	7	8
Nuisance Control	0	1	6	4	9
Human Threat	0	2	2	0	1
Illegal	0	2	1	3	4
Dogs	2	0	0	0	1
Road Kill	1	4	2	10	7
Self Defense	0	5	5	4	7
Train	0	1	1	0	0
Natural	0	2	5	6	5
Unknown	0	1	1	8	2
Wounding	0	0	0	1	0
Subtotal	5	25	31	45	48
Hunting					
Archery	30	38	44	49	66
Handgun	69	71	94	84	145
Rifle	60	57	87	100	142
Unknown	0	2	3	4	3
Subtotal	159	168	228	237	356
TOTAL	164	193	259	282	404

*This is an updated version; some changes have been made in previously reported data.

Table 14. Lion mortalities by MDFWP Regions, 1988-89 to 1992-93.

Region	1988-89		1989-90		1990-91		1991-92		1992-93	
	Hunt	Nonhunt	Hunt	Nonhunt	Hunt	Nonhunt	Hunt	Nonhunt	Hunt	Nonhunt
1	50	2	66	9	85	14	109	19	117	31
2	50	1	50	8	64	6	56	12	117	3
3	18	2	18	2	27	3	22	5	40	8
4	23	0	21	3	30	4	30	3	45	3
5	18	0	12	3	21	4	20	6	31	3
6*	0	0	0	0	0	0	0	0	3	0
7	0	0	1	0	1	0	0	0	3	0
8									(15)	(3)

* No open season in Region 6 prior to 1992-93.
( ) Number of lions killed in Region 8, 1992-93 are integrated into respective Regions 3 and 4 to compare with administrative boundaries of previous years.

1992-93 Mountain Lion Harvest Age and Sex Structure

The sex ratio of the 1992-93 harvest was similar to the previous four seasons (Table 15). Harvest statistics were summarized for each hunting district in Montana (Table 16). Many districts showed significant increases in lion harvest over the five-year period.

The age distribution of the statewide harvest has steadily increased over the past five years (Fig. 13). Lions aged 3 and older increased while those aged 1 and 2 decreased. The mean age of mountain lions in the harvest increased significantly ($P<0.05$) from 1988-89 to 1992-93 (Fig. 14). Mean age rose from 3.1 in 1988-89 to 7.1 for 1992-93, while the median age rose from 3 to 7. There was no difference in the mean age of lions between regions for each of the five hunting seasons compared ($P<0.05$). Mean age increased in 1992-93 in all regions (Fig. 15). The mean age of both males and females has risen since 1988 (Fig. 16).

The values obtained for the ages of harvested lions may be inaccurate due to age technique. Trainer and Matson (1988) have demonstrated that premolar aging can be conducted consistently; however, as stated above the accuracy is unknown. Readers should be warned that the actual values demonstrated in this data set may not be accurate, but trends across years probably reflect true tendencies in the age structure. Further analysis to correct for inaccuracies is planned. Using x-ray technique to validate younger aged lions will help control the errors in at least young age classes.

Table 15. Sex ratios of harvested mountain lions, 1989-1993.

Sex	Frequency				Percent			
	1989-90	1990-91	1991-92	1992-93	1989-90	1990-91	1991-92	1992-93
Males	124	155	154	233	73.8	68.3	65.6	66.2
Female	44	72	44	119	26.2	31.7	35.4	33.8

Table 16. Mountain lion harvest by hunting districts, 1988-89 through 1992-93.

Hunting Dist.	1988-89	1989-90	1990-91	1991-92	1992-93	Total
100	5	11	12	14	17	59
101	4	6	7	8	13	38
102	1	4	4	7	7	23
103	9	1	6	12	8	36
104	0	0	2	0	2	4
110	3	6	6	8	12	35
120	1	4	4	2	3	14
121	9	10	12	13	12	56
122	1	5	5	10	10	31
123	5	6	7	12	5	35
124	0	0	0	0	3	3
130	9	10	9	11	9	48
132	0	0	4	10	7	21
140	2	1	5	1	8	17
141	0	1	1	1	0	3
150	1	0	1	0	1	3
170	0	1	0	0	0	1

Table 16 continued.

Hunting Dist.	1988-89	1989-90	1990-91	1991-92	1992-93	Total
200	1	1	3	1	4	10
201	4	6	6	3	5	24
202	7	10	6	5	12	40
203	6	1	4	7	5	23
204	0	5	4	6	11	26
205	0	0	0	1	0	1
210	3	2	4	3	2	14
211	0	0	0	0	1	1
212	2	0	3	2	3	10
213	0	0	0	0	1	1
215	0	1	0	1	2	4
216	2	2	2	3	5	14
231	0	0	1	0	0	1
240	6	2	8	1	16	33
250	7	8	10	6	10	41
261	0	0	1	1	1	3
270	1	1	1	0	7	10
281	2	3	3	4	8	20
283	3	2	4	3	8	20
285	2	1	1	3	5	12
290	0	0	0	1	1	2
291	1	1	1	1	3	7
292	1	2	1	2	3	9
293	2	2	1	2	4	11

Table 16 continued.

Hunting Dist.	1988-89	1989-90	1990-91	1991-92	1992-93	Total
300	2	0	1	0	3	6
301	1	2	2	2	1	8
302	1	3	2	0	0	6
303	0	0	1	0	0	1
311	0	0	0	0	1	1
312	1	0	1	0	3	5
313	2	1	1	0	0	4
314	2	1	2	2	5	12
315	0	0	0	0	1	1
317	1	2	2	3	3	11
318	0	0	2	0	0	2
319	0	0	1	0	1	2
320	1	0	1	0	1	3
321	0	0	0	1	1	2
322	0	1	0	1	3	5
325	0	0	0	1	0	1
326	0	0	1	0	0	1
330	1	0	0	0	0	1
331	1	0	3	1	2	7
333	0	0	1	1	2	4
340	0	0	0	0	2	2
350	0	0	0	1	2	3
360	2	3	1	2	0	8
362	1	0	1	0	0	2
370	0	0	0	0	1	1
380	0	0	0	1	2	3
390	1	0	2	0	1	4
391	0	0	0	1	2	3
392	1	4	2	4	3	14
393	0	1	0	1	0	2

Table 16 continued.

Hunting Dist.	1988-89	1989-90	1990-91	1991-92	1992-93	Total
410	1	0	1	0	1	3
411	1	0	1	0	1	3
412	0	1	3	1	4	9
413	2	0	6	1	2	11
414	2	0	0	1	0	3
416	2	1	1	3	3	10
418	0	0	3	2	1	6
420	0	0	0	0	1	1
422	1	2	0	4	3	10
423	0	0	1	1	5	7
424	4	0	2	1	0	7
427	1	0	1	0	0	2
429	0	2	0	0	0	2
432	0	4	1	1	4	10
435	0	0	1	0	0	1
439	0	0	0	2	3	5
441	3	4	2	1	1	11
442	3	2	5	6	4	20
443	1	0	2	2	1	6
445	0	0	0	0	4	4
446	0	0	0	0	3	3
448	0	3	0	0	1	4
449	1	0	0	0	1	2
452	0	0	0	0	1	1
454	1	2	0	0	0	3
455	0	0	0	4	1	5
510	0	0	1	0	0	1
511	1	0	1	1	3	6
520	6	4	5	4	6	25
530	2	0	1	0	1	4
540	1	2	3	2	4	12
560	6	5	7	7	10	35
570	0	0	1	2	0	3
575	1	1	2	3	4	11
580	0	0	0	1	3	4
590	1	0	0	0	0	1
680	0	0	0	0	1	1
690	0	0	0	0	2	2

Table 16 continued.

Hunting Dist.	1988-89	1989-90	1990-91	1991-92	1992-93	Total
700	0	0	0	0	1	1
702	0	0	1	0	1	2
704	0	1	0	0	1	2

* Significant modifications were made in this table compared to previously reported results.

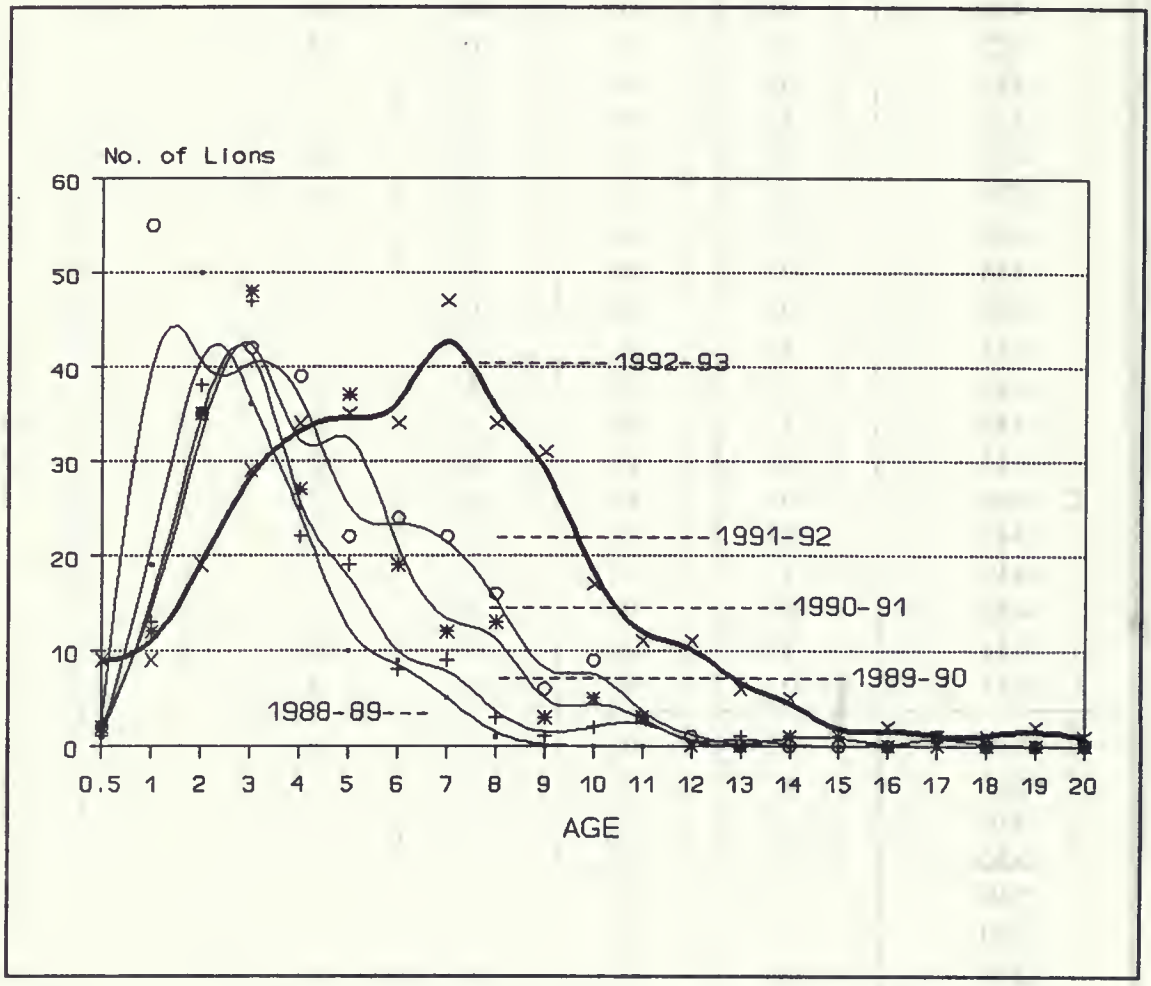


Figure 13. Age structure curves of the mountain lion harvest, 1988-93.

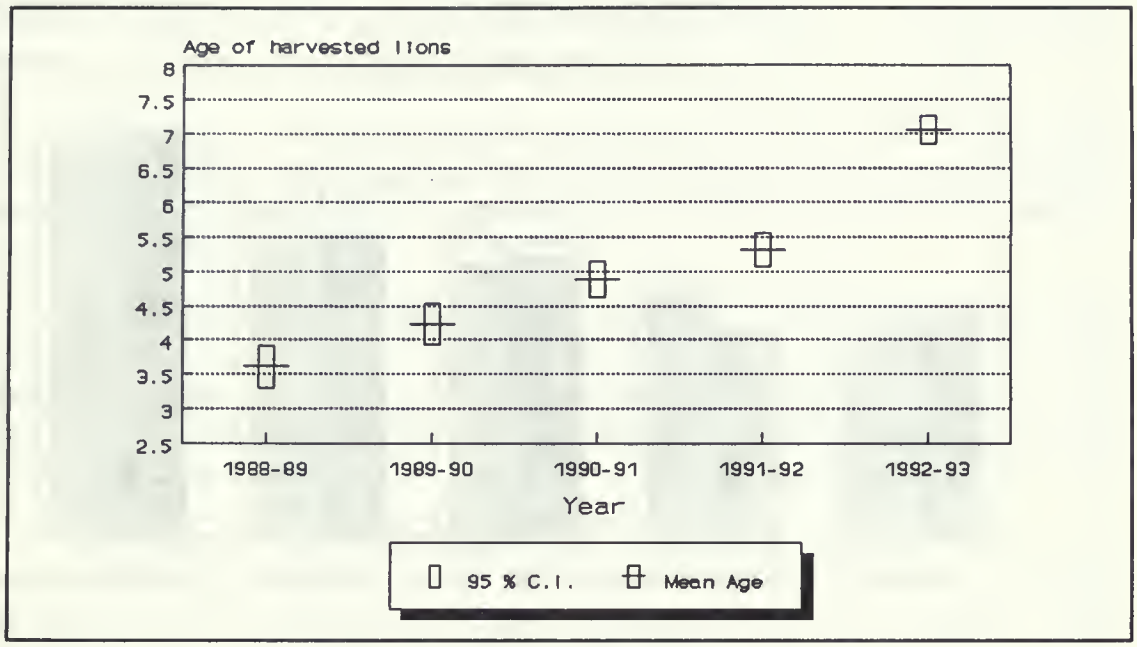


Figure 14. The mean age and 95% confidence interval of harvested mountain lions, 1988-93.

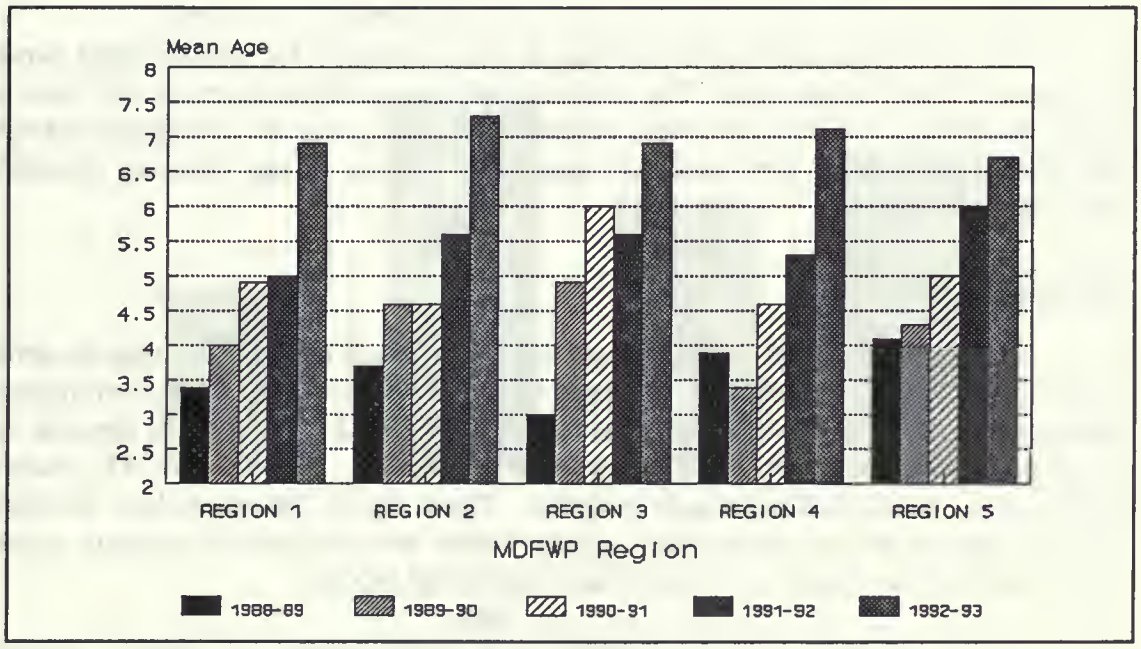


Figure 15. The mean age of mountain lions by region, 1988-93.

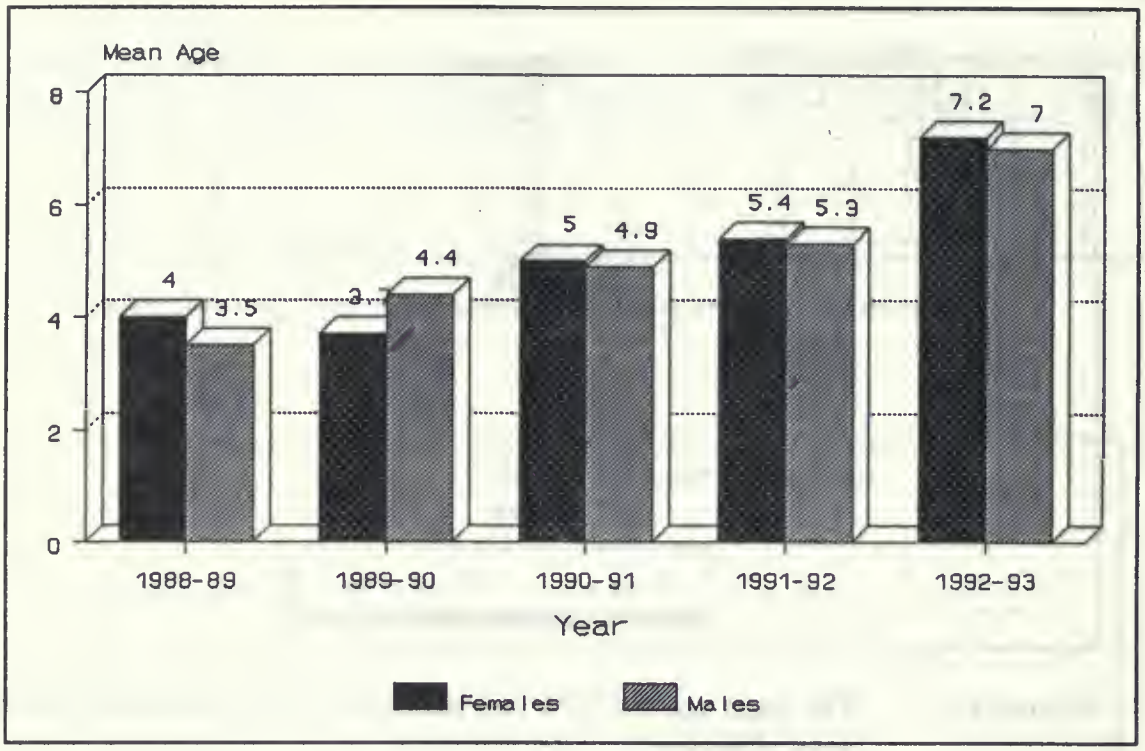


Figure 16. Mean age of lions harvested statewide by sex, 1988-93.

The tendencies observed in the data do raise concerns for the increased harvest of mountain lions in Montana. The mean age of male and female mountain lions has risen dramatically and the population, although still large, may be undergoing dramatic demographic changes. The results of significant changes in age structure cannot be predicted at this time.

Human/Lion Interactions

Interactions between mountain lions and humans were monitored during the period from July 1989 until August 1993. Records of interactions were compiled from regional newspaper articles, MDFWP written case reports, APHIS/ADC Disposition Reports, and necropsy reports from the MDFWP wildlife laboratory. A total of 143 incidents confirmed by wildlife officials were recorded. These reports did not include incidental sightings near homes or communities. Other reports were received by phone or written correspondence but could not be confirmed by official reports.

Actions of the lions were classified as livestock attacks, pet attacks, nuisance situations, predatory/aggressive behavior toward humans, and human attacks. All human attacks required actual contact with the human and resulting injuries inflicted by the cat. Predatory/aggressive behavior exhibited toward humans involved charges and sneak approaches toward humans, clawing the air, and vocalizations. In these aggressive

exhibits, no actual contact is made with the human involved. Nuisance situations involved lions frequently seen near homes, ranches, or communities.

A complete summary of previous lion incidents in Montana was compiled in May 1991 and published in the human-lion interactions symposium in Denver (Aune 1991). This project is ongoing, and results presented here include a brief summary including more recent findings.

Forty mountain lion incidents were reported in 1993, similar to the number reported in 1991 and 1992 (Fig. 17). The most frequent interactions involved livestock attacks and predatory/aggressive interactions where the mountain lion is perceived as a threat to an individual (Fig. 18). The number of aggressive/predatory encounters reported rose from 6 in FY1990 to 16 in FY1992, then declined slightly to 10 in 1993.

Differences in lion incident types and trends appear to vary with human use and demographic patterns within the state. The number of incidents in Region 1 increased significantly in 1993 while declining in most other regions (Fig. 19). The number of all lion incidents reported in 1992 was slightly higher than for other years in Regions 2 and 4. Livestock-lion incidents are the most frequently reported interaction in Regions 3, 4, and 5 while human-lion incidents occur more frequently in Regions 1 and 2 (Fig. 20).

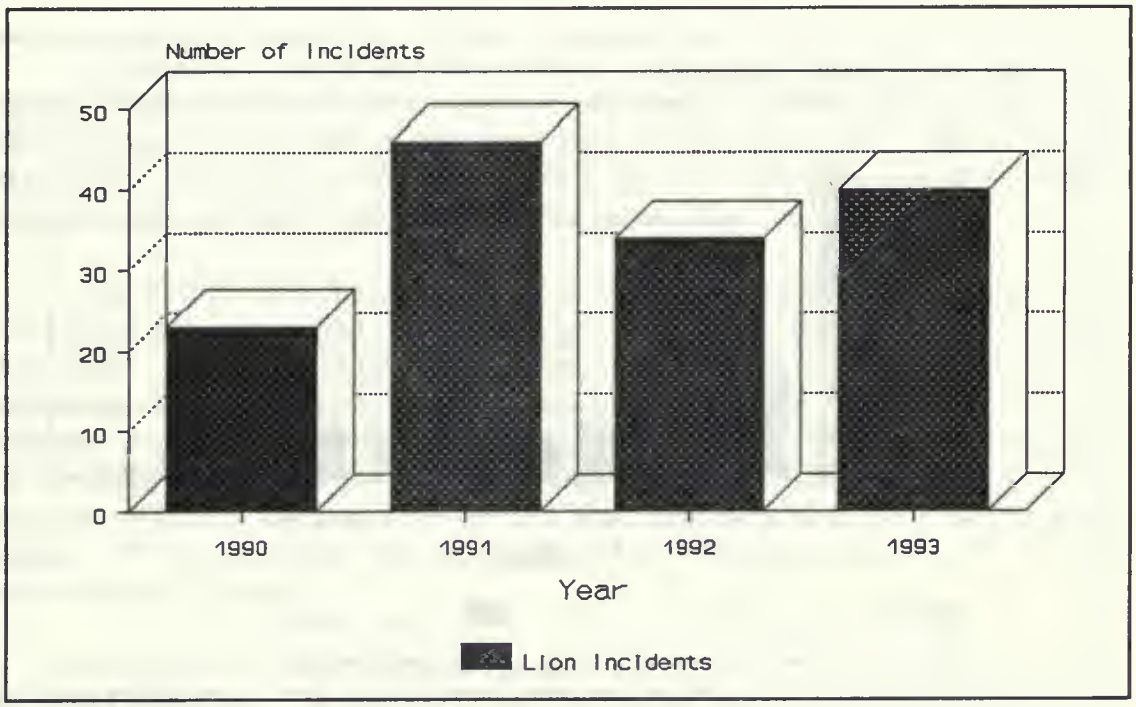


Figure 17. Mountain lion incidents in Montana during fiscal years 1990-93.

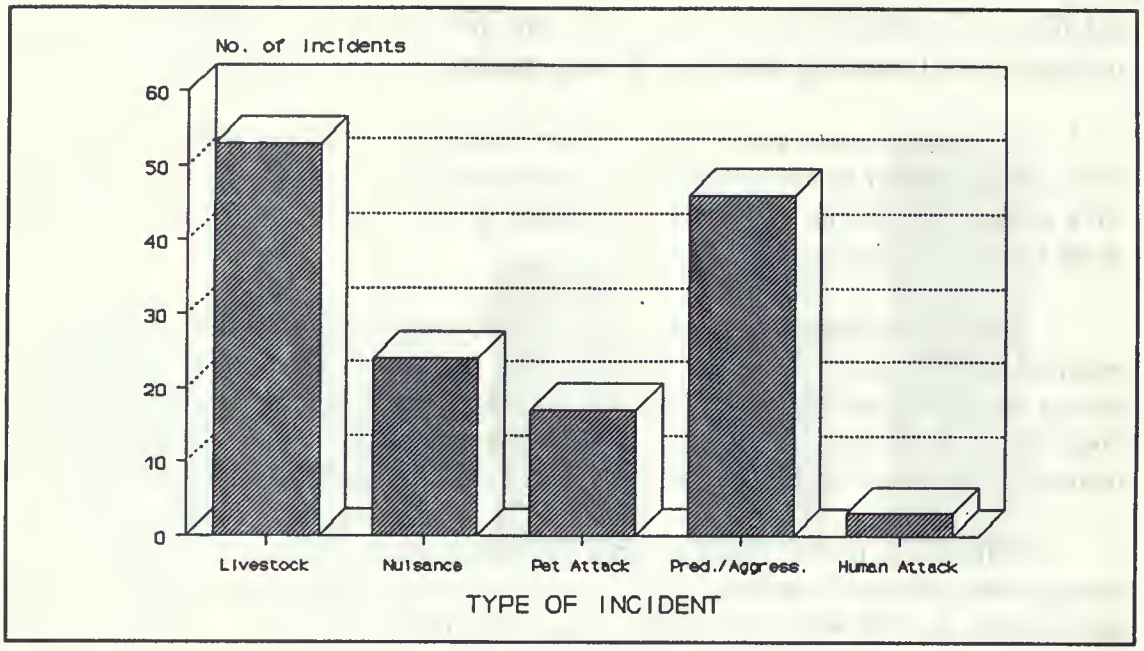


Figure 18. Frequency of mountain lion incidents by class in Montana during fiscal years 1990-1993.

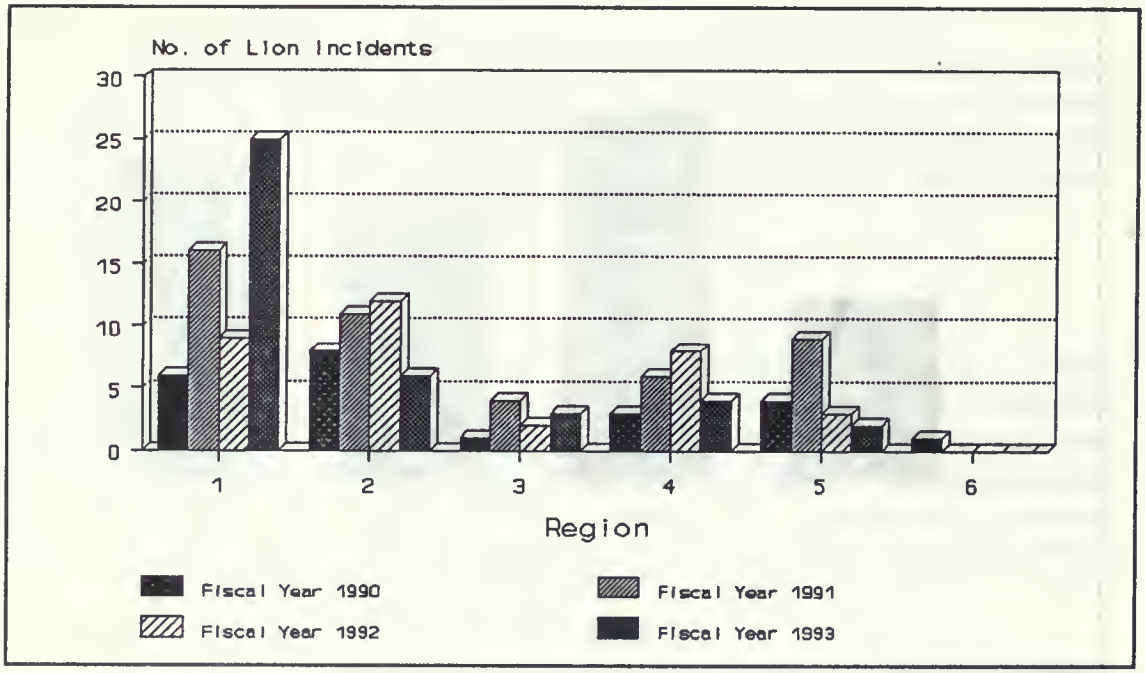


Figure 19. Comparison of reported lion incidents in Montana by fiscal years, 1990-93.

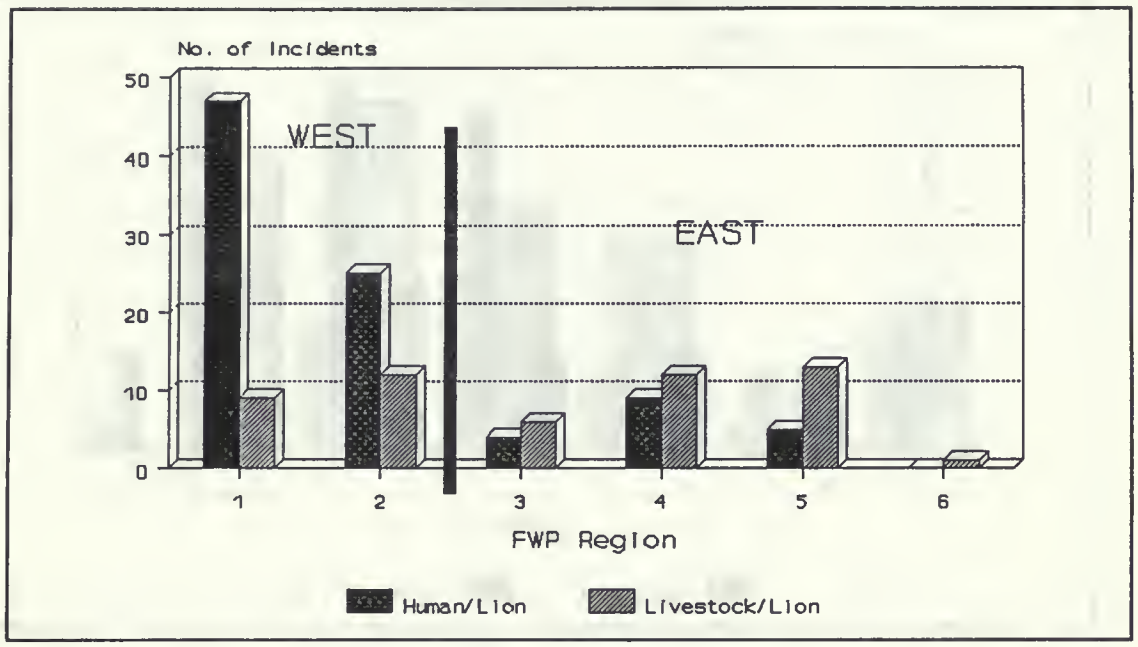


Figure 20. Human/lion and livestock/lion incidents by region in Montana during fiscal years 1990-93.

Fifty-three (31.1%) of the 143 incidents reported in this period were classified as livestock attacks. Lions were captured and relocated, or killed in 29 (54.7%) of the livestock cases. Thirty-two of the cases (60.4%) involved sheep. Other reported livestock/lion incidents involved rabbits, goats, poultry, cattle, and horses. Livestock cases primarily occurred in the April-October period (Fig. 21).

Aune (1991) found the ratio of males to females consistently skewed toward males in livestock-lion interaction while females were more prevalent in human-lion interactions. Continued examination of sex ratios in offending lions confirms this observation (Fig. 22) Ages were recorded for 76 of the lions involved in the 143 incidents. Forty-five (59.2%) of the lions whose age could be determined were aged as 2 or less (Fig. 23). Aune (1991) hypothesized that most of the lions were dispersing subadults. Further investigations confirm that most offending lions are young or subadult. This is consistent with the impulse of a strong age cohort found in the age distribution of the harvest.

Mountain lion actions reported to MDFWP by the APHIS/ADC has increased since 1967 (Fig. 24). A significant and continuous need for field actions occurred beginning in 1983. Prior to 1983, APHIS/ADC records of depredation actions were infrequent. Another sudden and significant increase in ADC lion actions occurred in 1993.

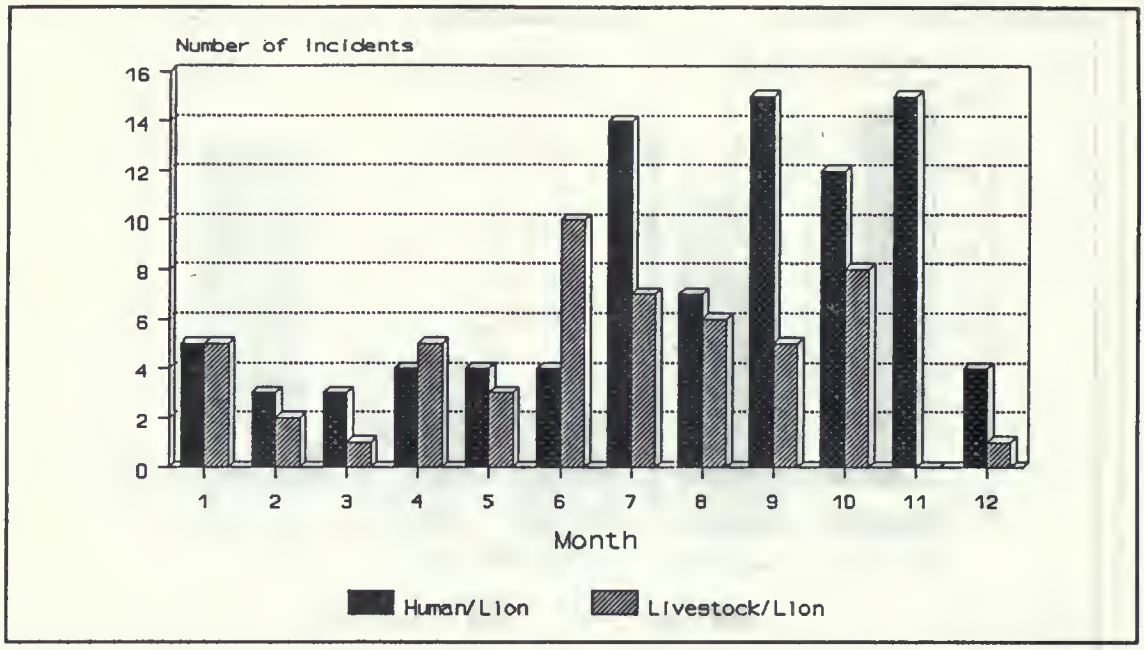


Figure 21. Human/lion and livestock/lion incidents by month, fiscal years 1990-93.

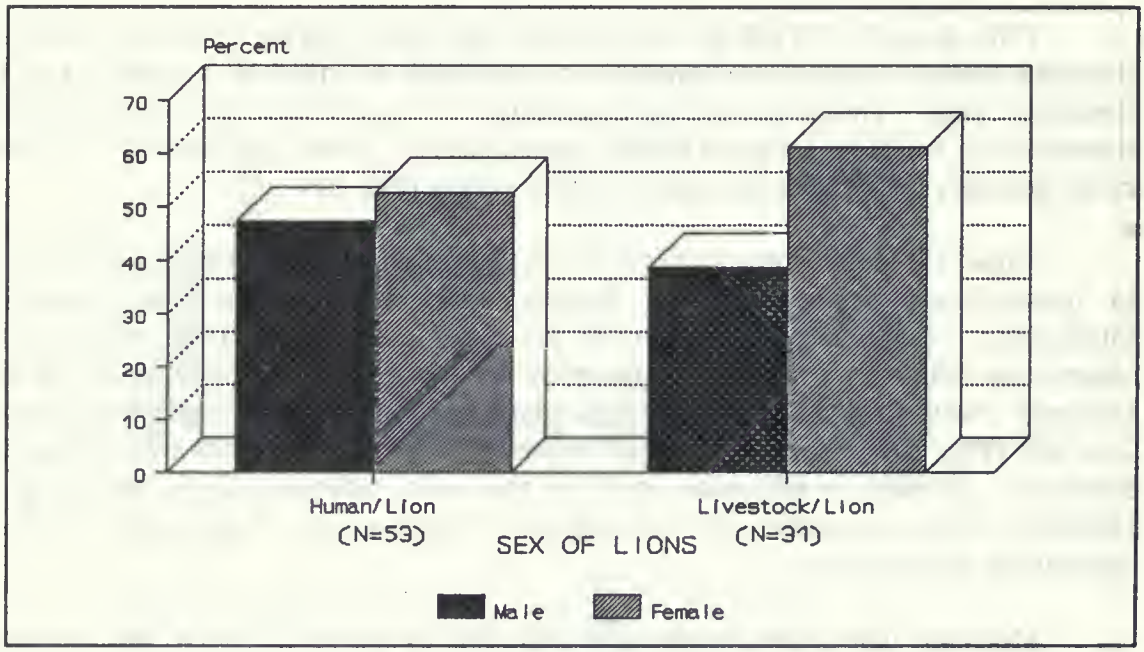


Figure 22. Sex ratio of mountain lions involved in human/lion and livestock/lion interactions in Montana during fiscal years 1990-93.

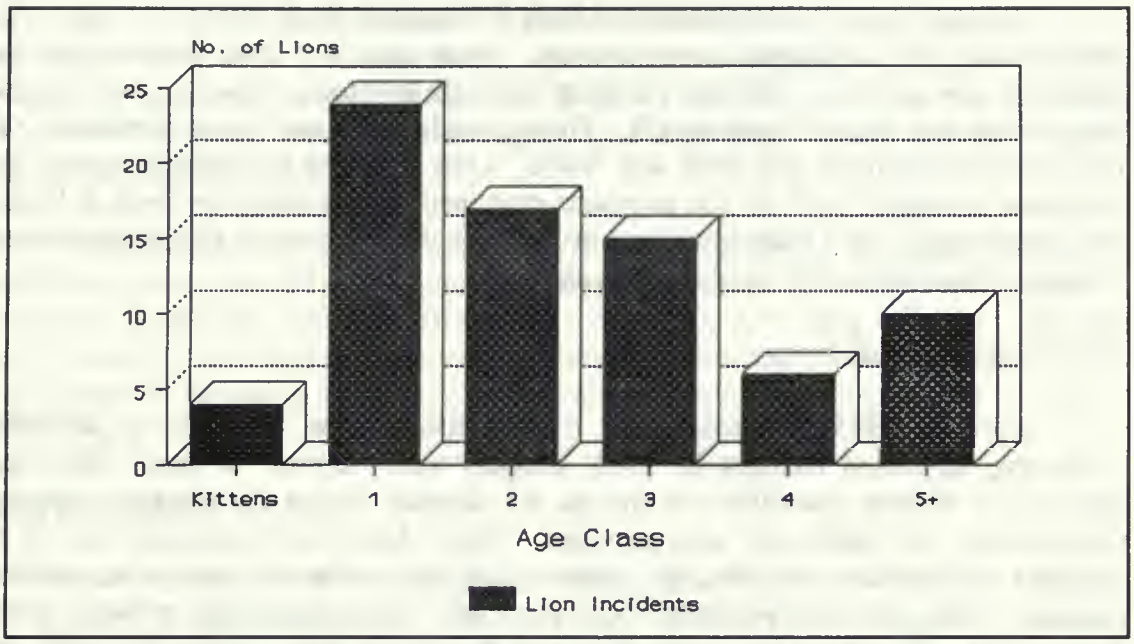


Figure 23. Age of mountain lions involved in all lion incidents in Montana, fiscal years 1990-93.

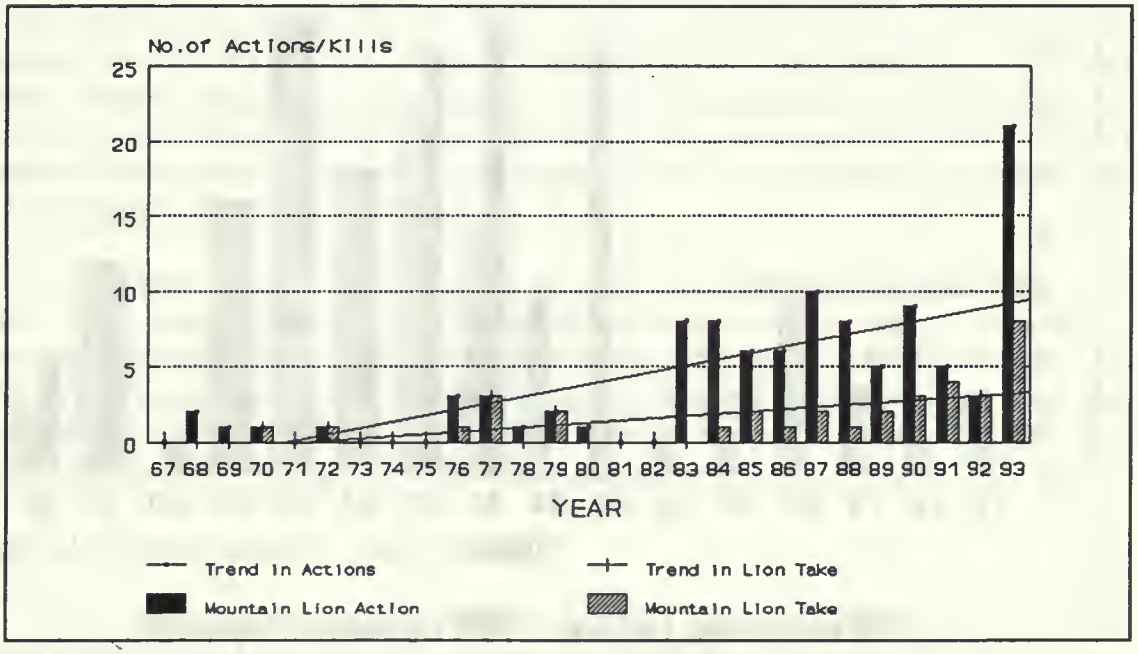


Figure 24. APHIS/ADC mountain lion depredation actions in Montana, 1967-93.

Stomach contents were examined from 49 mountain lions involved in human/lion interactions. Fifteen stomachs were empty. Nine lions fed upon domesticated pets including cats and dogs. Six had fed upon domestic livestock. Fourteen had fed upon white-tailed deer and one upon an elk. Three lions had fed upon small mammals. One lion stomach contained only cloth and debris. Lion stomachs with anthropogenic food resources comprised 56% of lion stomachs examined from animals involved in human/ lion interactions. Of 12 lions involved in livestock depredations, 6 (50%) had stomach contents with evidence of the depredations.

Fisher Carcass Study

Prior to 1985, all incidentally trapped fisher were turned in to MDFWP. Following regulation changes in 1985, trappers were allowed to keep fisher furs; however, it became mandatory to provide the skinned carcass for research purposes. Occasionally, the skull only was provided. There have been inconsistencies in the numbers of carcasses provided by trappers and the number of harvest registrations reported. Several years produced more carcasses than registrations recorded in the harvest data. To correct for errors in harvest registration data, carcass collection data were examined to derive a reconciled harvest summary (Fig. 25).

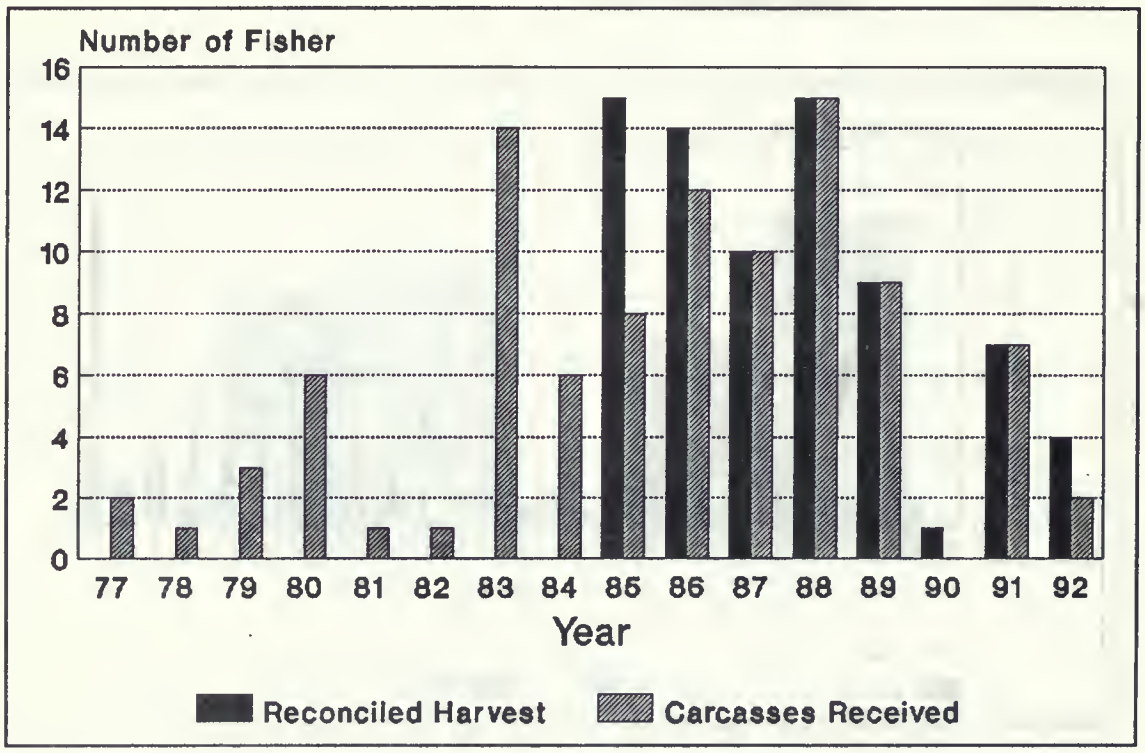


Figure 25. Fisher harvest and carcass collections in Montana, 1977-1992.

Ninety-five fisher carcasses or skulls have been examined at the Wildlife Laboratory since 1977. All specimens examined were trapped in Regions 1 or 2. Twenty-six specimens were identified from Region 1, while 50 samples were known to come from Region 2. An additional 19 specimens came from western Montana, but the region of collection was not known.

Trapping district was recorded for 59 of 95 specimens collected. Region 1 specimens were collected from hunting districts 104, 110, 130, and 140. Region 2 specimens came from hunting districts 202, 203, 240, 250, 270, and 283. Harvest registrations indicate fisher were trapped on the Blackfeet and Flathead Indian Reservations in Montana; however, carcasses are not required to be examined from these jurisdictions.

Age and Sex Structure

Sex was determined for 94 specimens. Sex ratios statewide were 50% male and 50% female. Sex ratio in Region 1 was 57.7F:42.3M. Sex ratio for Region 2 specimens were 42.9F:57.1 M. There was no statistical difference in sex ratios of specimens when comparing Region 1 and Region 2 (Chi-square 1.498, 1 d.f., P=0.221).

A specific age was determined for 65 of 95 specimens from 1977-1993. Mean age for all specimens was 2.30 (S.D.=2.53) with no difference between males or females in the sample (t=0.323, p=0.747). Ages ranged from juvenile (0.5) to 9.5, and age distributions of males and females were similar (Fig. 26). Age distributions were also similar between Regions 1 and 2 (Fig. 27). Juveniles comprised 40.4% of the harvest during this time period. There was no difference in the mean age of fisher reported from Region 1 (2.26 years) and Region 2 (2.47 years) (t=-0.25, p=0.801). The median age in both regions and statewide was 1.5 years.

Age data were stratified by time periods, 1977-1985 (N=33) and 1986-1993 (N=32), to compare changes following regulations implemented in 1985. The mean age for fisher collected in the earlier time period was 2.59 years (S.D.=2.75) and 2.03 (S.D.=2.17) years more recently. There was no statistical difference in the mean age between time periods (t=0.908, p=0.367). Juveniles comprised 36.3% (1977-85) and 43.8% (1986-93) of the harvest in each time period.

Physical Characteristics and Body Condition

The mean skinned weight of fisher carcasses was 2.27 kg. (S.D.=0.56). The mean weight of male and female carcasses was 3.03 kg. (S.D.=0.758) and 1.64 kg (S.D.=0.33), respectively. Male carcasses were significantly heavier than females (t=-9.61, p=0.0009E-10). Mean weight of adult males (3.10 kg, S.D.=0.75) was not significantly different than that of juvenile males (2.51 kg, S.D.=0.33) (t=1.68, p=0.112). Likewise, the mean weight of adult females (1.66 kg, S.D.=0.325) was not different than that of juvenile females (1.65 kg, S.D.=0.313) (t=0.012, p=0.99).

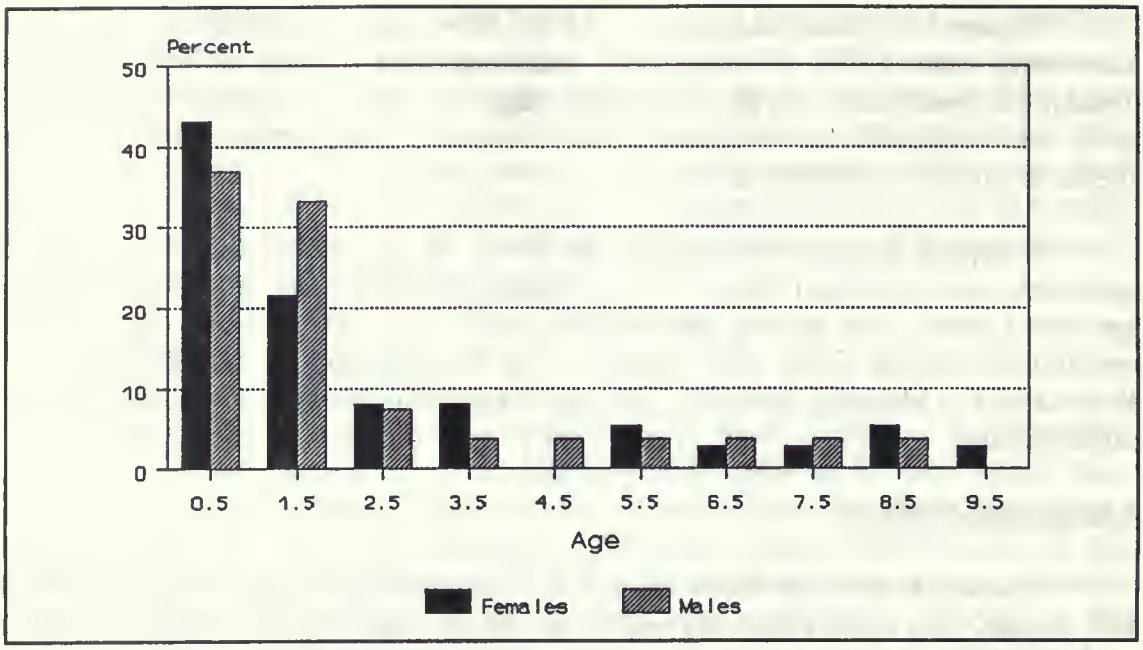


Figure 26. Age distribution of harvested fisher by sex, 1985-1992.

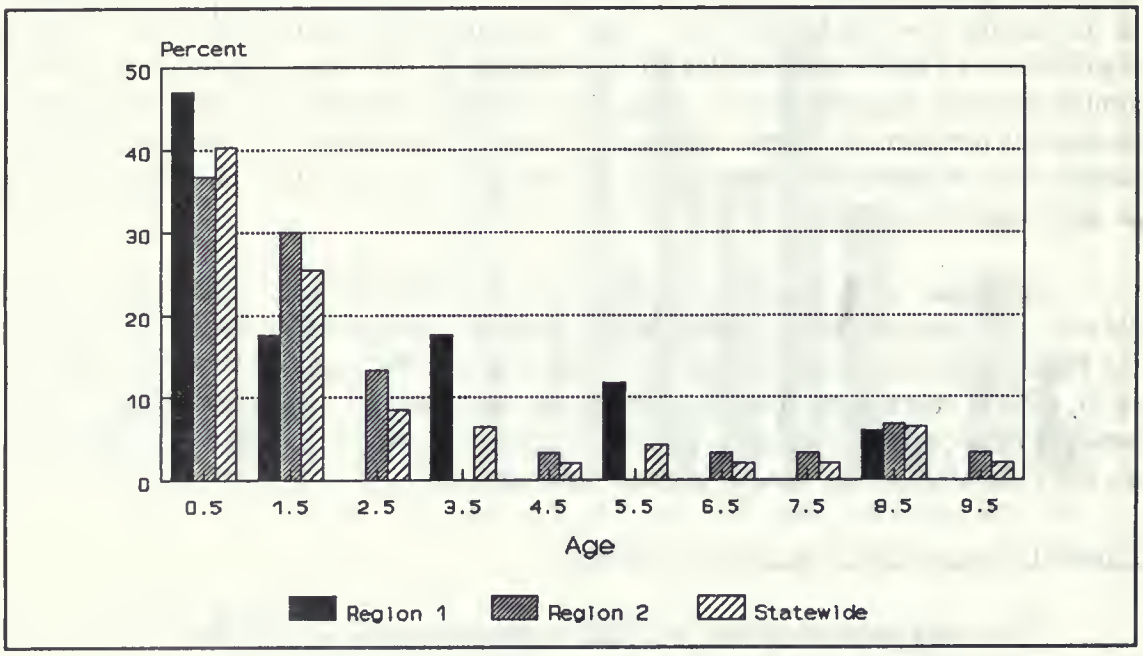


Figure 27. Age distribution of fisher trapped in Montana, 1985-1992.

Body fat index based on visual assessment of fat level (1=best, 5=poor) was normally distributed around an average index value of 3 (Fig. 28). There was little difference in the index distribution comparing male or female carcasses.

Figure 28. Distribution of body fat index for male and female fisher carcasses collected in Montana, 1985-1992.

Food Habits

Eighty-four stomachs and 83 colons were examined to determine food habits. Of these, 37 stomachs and 41 colons were empty. Twenty-one stomachs and 19 colons contained only trap bait, debris, digested meat residue, or combinations of these, so they were excluded from the analysis of food habits. Twenty-six stomachs and 23 colons contained food items accurately reflecting the natural selection of food items by fisher. The volume of food items in two colons was insufficient to measure, and results were used only in frequency calculations.

Sample size of stomachs and colons limited the analysis to broad food categories. A preliminary examination of food items indicates that fisher used five major categories of food including cervids, rodents (about 60% mice and 40% larger rodents), lagomorphs (rabbits), birds, and insects (Table 17). Detailed presentations of fisher food habits will be conducted following increased sampling of fisher carcasses collected by Montana trappers in the future.

Table 17. Food habits of Montana fisher based on examination of stomach and colon contents. Figures are percent frequency of occurrence/percent of total diet.

Food Item	Stomachs (N = 26)	Colons (N = 21)
Cervid	35/31.2	22/19.0
Rodent	23/18.8	26/23.8
Lagomorph	23/16.7	26/28.6
Bird	19/15.4	13/14.3
Insect	8/4.4	9/9.5
Miscellaneous	15/13.5	4/4.8

There were differences in the occurrence of cervids in the stomachs and colons of fisher. The greater representation in stomachs may reflect use of cervids for trap bait. We were unable to distinguish natural and unnatural sources of cervids in the diet of fisher. It was assumed that corrections for the use of cervids as bait would tend to reduce their value as a food item. It is our preliminary conclusion that, despite the high occurrence of cervids in fisher stomachs, lagomorphs and rodents are the primary food items consumed by fisher. Fisher also scavenge carcasses of cervids and prey on birds in Montana.

Reproduction

Nineteen reproductive tracts have been collected from fisher carcasses. The tracts varied in condition with many unsuitable for histologic sections. The length of each uterine horn and ovary weight were measured. Ovaries from adult fisher in suitable condition were serially sectioned and corpora lutea counted. Review of these tracts was conducted by an MSU senior in wildlife biology for preparation of a paper for biology problems credits.

There was a significant difference in the mean length of uterine horns for juvenile (38.6 mm, S.D.=7.95) and adult (52.3 mm, S.D.=11.4) fisher ($t=2.26$, $p=0.050$). There was no difference in the mean weight of ovaries from juvenile (0.026 gm., S.D.=0.18) and adult (0.18 gm., S.D.=0.014) fisher. There was no difference in the mean length or ovary weight when comparing left and right halves of the reproductive tract. Observations indicate that juvenile tracts are narrow and can be distinguished from adults by their shorter length.

Histologic sections were produced from 16 pair of ovaries. The ovaries in three tracts were severely autolytic and histology was not attempted. Corpora lutea were not observed in five tracts from juvenile fisher. One of five tracts (20%) from 1 year old fisher had corpora lutea. Five of six tracts (83.3%) from fisher aged 2 years and older had corpora lutea. Mean number of corpora lutea for all fisher was 2.17 (S.D.=1.17) and ranged from 1 to 4. Corpora albicantia were observed in one female tract.

Following the dissection of ovaries, the uterus was cleared in evergreen oil and inspected for evidence of placental scars. Ten fresh tracts from recent carcasses and 11 additional tracts that had previously been cleared were examined. No placental scars were detected in any reproductive tract. It was not determined whether the processing of the tracts caused scars to disappear or if the data were representative of the reproductive condition of the specimens. All the tracts collected were from December and January. Fisher do not implant until January and February (Douglas and Strickland 1987). This may explain why we were unable to detect any recent scars from the samples examined. The poor condition of our tracts and extensive freezing prior to processing prevented the flushing of blastocysts.

Summary

Fisher carcass collections will need to be conducted over a long period before detailed evaluations of results can be completed. Previous collections were conducted; however, evaluations were inconsistent and processing variable. It is essential that new collections be thoroughly examined to enhance the data used for this preliminary evaluation.

Preliminary data suggests that Montana fisher reproduction may be limited to females older than 2 years of age. Yearling fisher are occasionally ovulating. The mean number of corpora lutea for all females older than 1.5 years (2.17) is lower than means reported for Ontario (3.35) and Maine (3.0). More data will be necessary to accurately evaluate the reproductive potential of Montana fisher populations.

Data from stomach and colon analysis suggest that lagomorphs and rodents are the most common prey items in Montana fisher. Further collection of stomach and colon data are needed to examine regional differences in food habits.

Age distributions indicate that a large proportion of the harvest comes from juvenile and yearling fisher. Some individual fisher are surviving to attain ages of up to 9.5 years. No change is evident in age structure of carcasses collected comparing the pre- and post-1986 periods.

Pine Marten Carcass Study

Age and Sex Structure of the Harvest

Pine marten age structure curves were derived from carcass collections in Region 1 for 1989-1992 and Region 3 for 1987-1992. We were unable to construct age distributions for Region 2 because of variable participation in the carcass collections and inconsistent or small sample sizes.

Pine marten age structure in Region 3 has been somewhat variable (Fig. 29). Declines in the percentage of juveniles in 1989 and 1992 were dramatic. A reduced sample of carcasses in 1992 could explain some of the variation that year. Age structure in Region 1 was very stable from 1989-1991, then the percentage of juveniles declined abruptly in 1992 (Fig. 30).

The mean age of pine marten in Region 1 has varied from 1.2 to 2.2, and averaged 1.56 years from 1989-92. The mean age has risen significantly from 1989 to 1992 (Fig. 31). The mean age of pine marten in Region 2 was similar for the years 1989 and 1990 (Fig. 32). An insufficient number of carcasses were collected in Region 2 to calculate mean age for other years. The mean age of pine marten in Region 3 has varied from 1.32 to 1.81 and averaged 1.62 from 1987-1992. There was no significant change in the mean from 1987 to 1992 (Fig. 33).

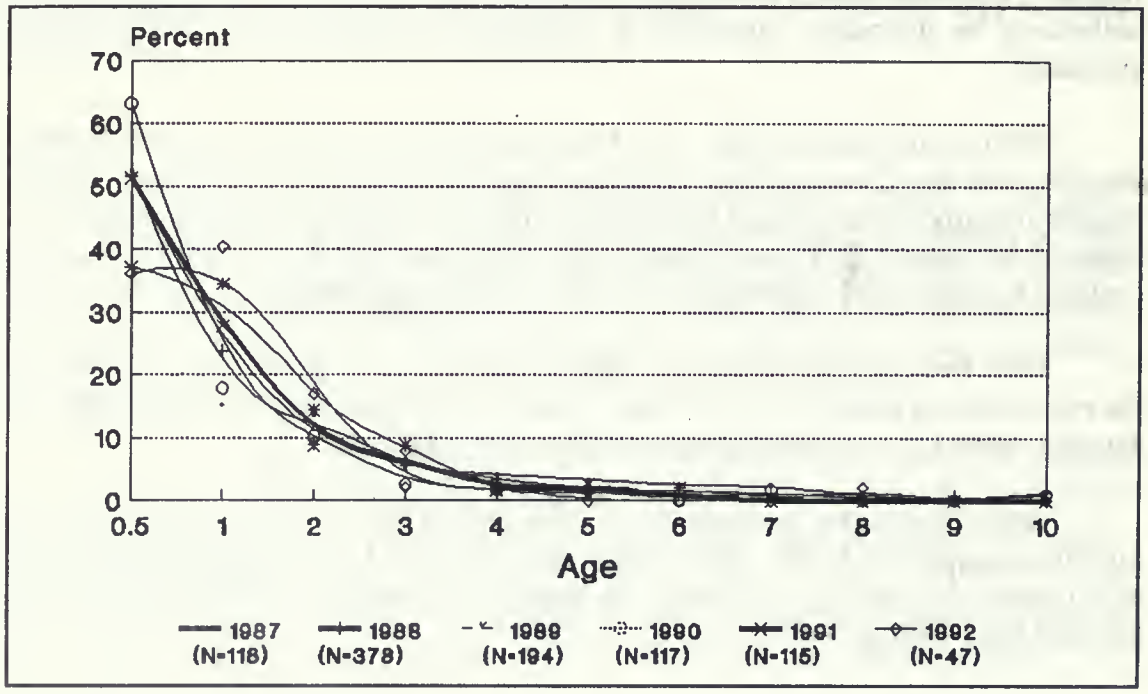


Figure 29. Pine marten age distribution curves for Region 3, 1987-1992.

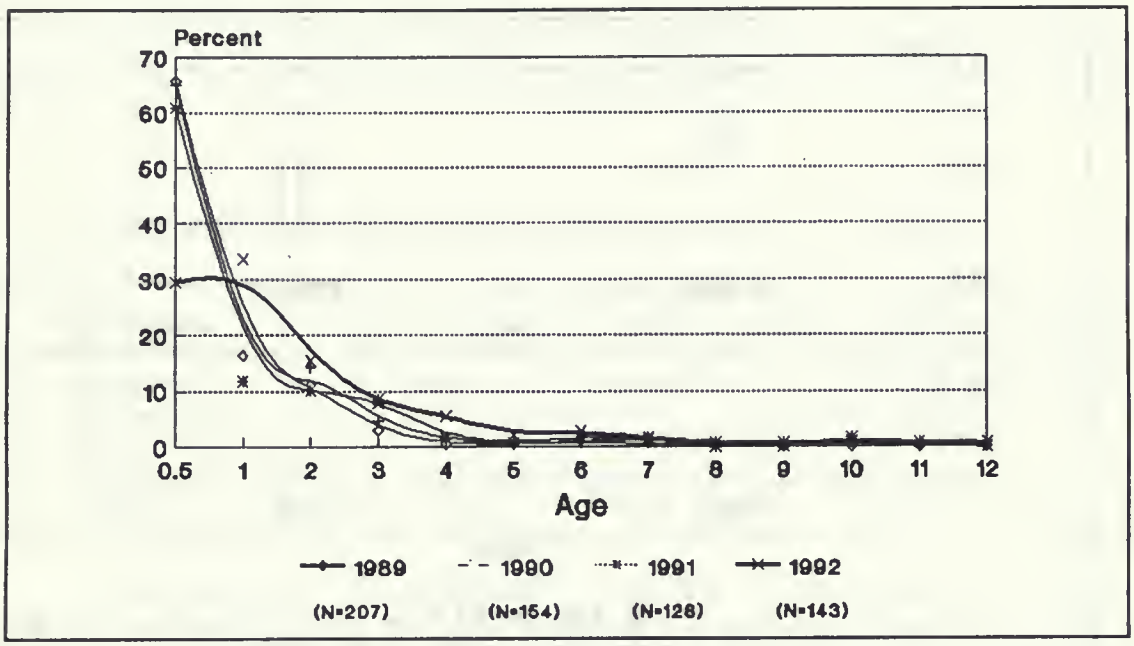


Figure 30. Pine marten age distribution curves for Region 1, 1989-1992.

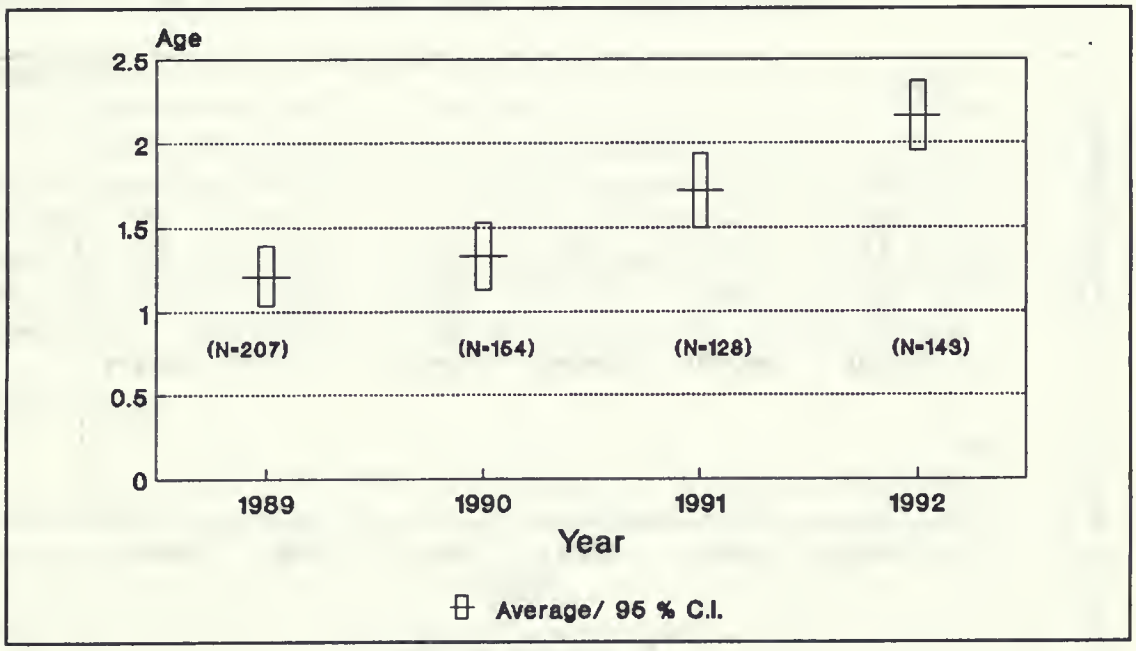


Figure 31. The mean age and 95% confidence interval for pine marten collected in Region 1, 1989-92.

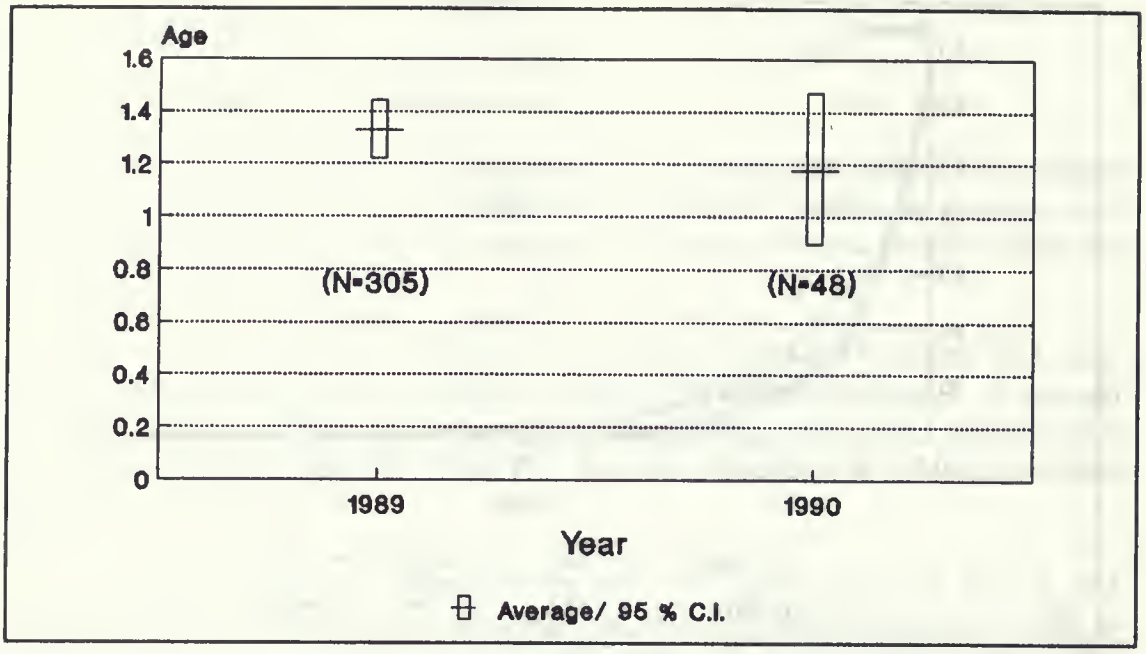


Figure 32. The mean age and 95% confidence interval for pine marten collected in Region 2, 1989 and 1990.

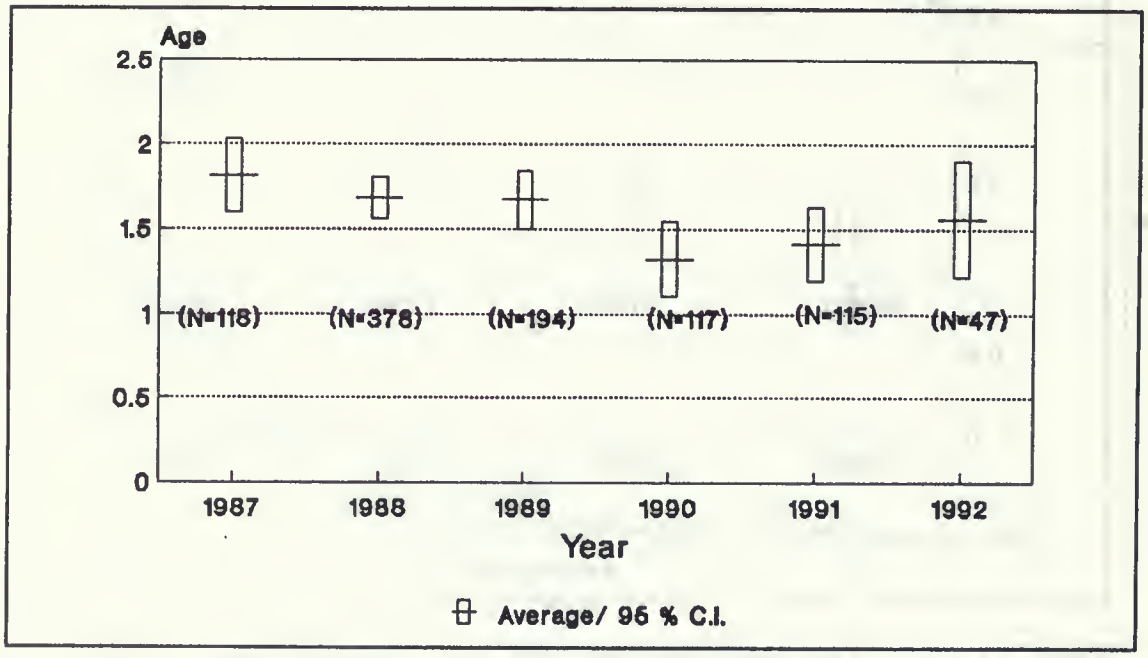


Figure 33. The mean age and 95% confidence interval for pine marten collected in Region 3, 1987-1992.

Sex ratio of the harvest in all regions has been similar between years and between regions (Table 18). Female harvest has remained between 33 and 46% for the years sampled.

Table 18. Percentage females in the pine marten harvest by region and year.

Region\Year	1987	1988	1989	1990	1991	1992
Region 1	-	-	40.2	41.3	34.5	41.6
Region 2	-	-	43.7	32.7	-	-
Region 3	43.0	42.7	42.8	42.9	43.7	46.1

The harvest of juveniles declined sharply in 1992 in both Regions 1 and 3. We could not confirm this pattern in Region 2 because only seven carcasses were submitted for the season. The cause of the apparent decline in juvenile marten in 1992-93 is unknown. Field research on pine marten in Region 3 also indicated a decline in juveniles during 1992 (Ken Coffin, pers. comm.). Lowered production for this year could affect harvests for the 1993-94 trapping season and subsequent seasons.

Food Habits

Results from the examination of stomach and colon contents indicate that the diet of pine marten was similar in 1991-92 to those reported for 1988-89, 1989-90, and 1990-91 (Table 19). For the period 1988-1992, 527 colons and 527 stomachs have been examined for food content. Findings have been reported in Aune and Schladweiler (1991 and 1992). A detailed summary of conclusions is under preparation and should be expected to be released and ready for publication by the next annual report.

Bobcat Studies

Bobcat skulls were collected from trappers in Regions 2 and 3 during the 1988-89 through 1992-93 trapping seasons. Age was determined by examining the pulp cavity to discern juveniles, followed by cementum annuli counts for those older than juvenile. The mean age of bobcats collected in Regions 2 and 3 combined has remained stable since 1988 (Table 20). Mean age of bobcats collected from each Region has been variable from 1988 to 1992 (Table 21). There was no difference in the mean age of males and females for the years 1988-89 through 1992-93 ($P<0.05$) (Table 22).

Table 19. Winter 1991-92 food habits of Montana marten as determined from examination of stomach and colon contents. Figures are percent frequency of occurrence/percent of total volume of food items.

FOOD ITEM	Stomachs (N = 83)	Colons (N = 78)
Cervid	22/18.9	12/7.6
Unid. large mammal	1/0.7	-/-
TOTAL LARGE MAMMAL	23/29.7	12/7.6
Red squirrel	1/0.3	1/1.1
Wood rat	2/3.0	-/-
Beaver	1/0.6	1/0.6
TOTAL "LARGE" RODENT	5/3.8	3/1.7
Chipmunk	-/-	1/0.4
Microtus	7/6.3	-/-
Clethrionomys	31/28.4	6/7.9
Unid. Microtine	7/5.7	21/21.6
Peromyscus	4/2.2	1/0.8
Unid. Mouse	36/15.1	47/37.0
TOTAL "SMALL" RODENT	83/57.7	76/67.8
LAGOMORPH	16/9.9	8/5.8
BIRD	11/4.9	9/5.7
VEGETATION	6/2.0	9/6.5
MISCELLANEOUS	5/2.0	6/4.8
Total volume (cc)	1431	355

Table 20. Mean age of bobcats collected in Regions 2 and 3, 1988-1992.

Year	N	Mean Age	95% C. I.
1988-89	129	2.50	2.24-2.76
1989-90	105	2.47	2.18-2.76
1990-91	69	2.11	1.74-2.47
1991-92	183	2.13	1.91-2.35
1992-93	193	2.37	2.16-2.59

Table 21. Mean age of bobcats by year and region, 1988-1992.

Parameter	N	Region 2	N	Region 3
Mean Age 1988-89 95% C.I.	25	2.22 1.61-2.83	41	2.60 2.18-3.01
Mean Age 1989-90 95% C.I.	82	2.51 2.17-2.85	20	2.10 1.50-2.70
Mean Age 1990-91 95% C.I.	47	2.07 1.63-2.52	17	2.44 1.80-3.09
Mean Age 1991-92 95% C.I.	64	2.20 1.81-2.58	72	1.92 1.60-2.23
Mean Age 1992-93 95% C.I.	102	2.42 2.12-2.73	73	2.28 1.96-2.59

Table 22. The mean age of bobcats by sex in Regions 2 and 3 combined, 1988-1992.

	Mean Males	95 % Confidence Interval	Mean Females	95 % Confidence Interval
1988-89	2.50	1.45-3.55	1.93	0.88-2.97
1989-90	2.57	2.11-3.04	2.50	1.96-3.04
1990-91	2.24	1.76-2.72	2.07	1.54-2.59
1991-92	2.42	2.09-2.76	1.65	1.29-2.00
1992-93	2.41	2.06-2.75	2.10	1.81-2.39

Sex ratio of all bobcats harvested in Regions 2 and 3 combined did not differ significantly between years from 1988-1992 (Table 23). In 1992-93, the ratio shifted to favor females slightly and occurred in both Regions 2 and 3 (Table 24).

Table 23. Sex ratio of harvested bobcats in southwest Montana, 1988-1992.

Sex	1988-89	1989-90	1990-91	1991-92	1992-93
Female	47.4	40.0	42.4	44.1	55.3
Male	52.6	60.0	57.6	55.9	44.7

Table 24. Sex ratio of harvested bobcats by MDFWP region, 1991-1992 and 1992-93.

Sex	Region 2		Region 3	
	1991-92	1992-93	1991-92	1992-93
Female	40.0	55.7	43.3	52.5
Male	60.0	44.3	56.7	47.5

Annual age distributions for Regions 2 and 3 combined for 1988-89 through 1992-93 were developed (Fig. 34). The number of juveniles has remained stable, fluctuating between 29.0 and 35.5% over the last five trapping seasons. Few bobcats were aged over 9 years old, and the oldest was aged at 14.5 years. Juveniles and one year old bobcats comprised an average of 57.2% of the population for this period.

A comparison of age distributions for Regions 2 and 3 for the most recent two years indicated little change between years (Fig. 35 and Fig. 36).

The percentage of juveniles in Region 2 has varied from 24.0% in 1988 to 37.5% in 1991. The percentage of juveniles in Region 3 declined for three years 1988-90 from 36.6% to 17.6%, then rose to 33.3% in 1991 and 32.9% in 1992. There was little difference in the age distribution curves between Regions 2 and 3.

Wolverine Studies

Montana trappers have been required to submit wolverine carcasses to the Wildlife Laboratory since 1974. During the report period all records of wolverine harvested since 1967 were compiled and reconciled to carcass collections (Fig. 37). The wolverine harvest has fluctuated between a low of 6 in 1992-93 and a high of 43 in 1976-77. For the most recent six years, wolverine harvest has remained below 10 annually.

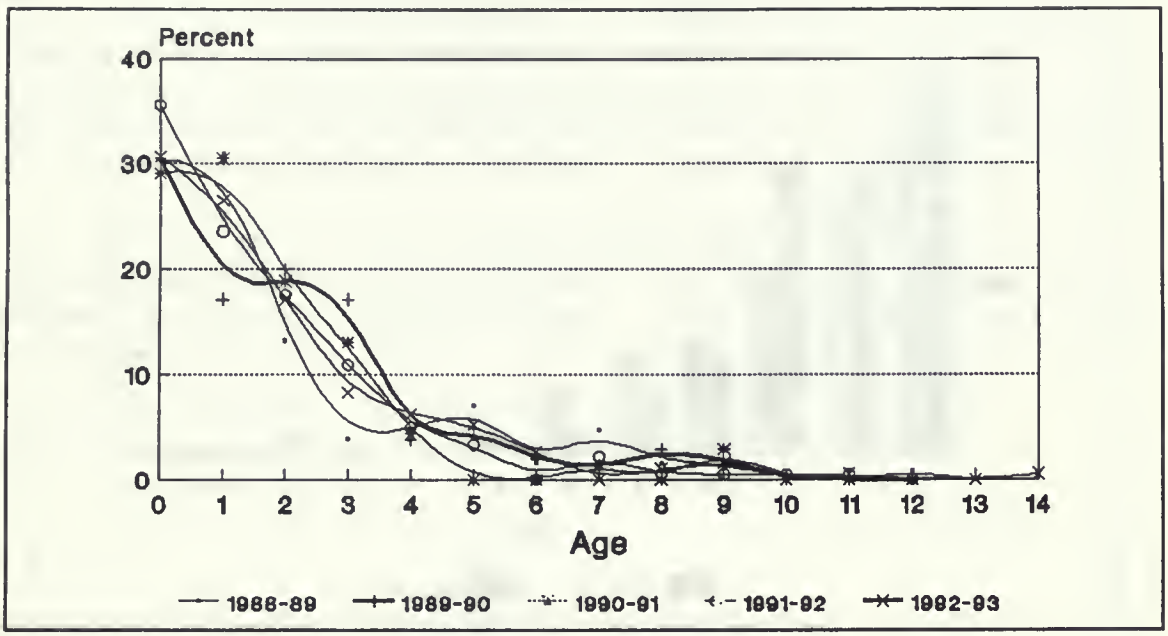


Figure 34. Comparison of pooled bobcat age distributions for Regions 2 and 3, 1988-92.

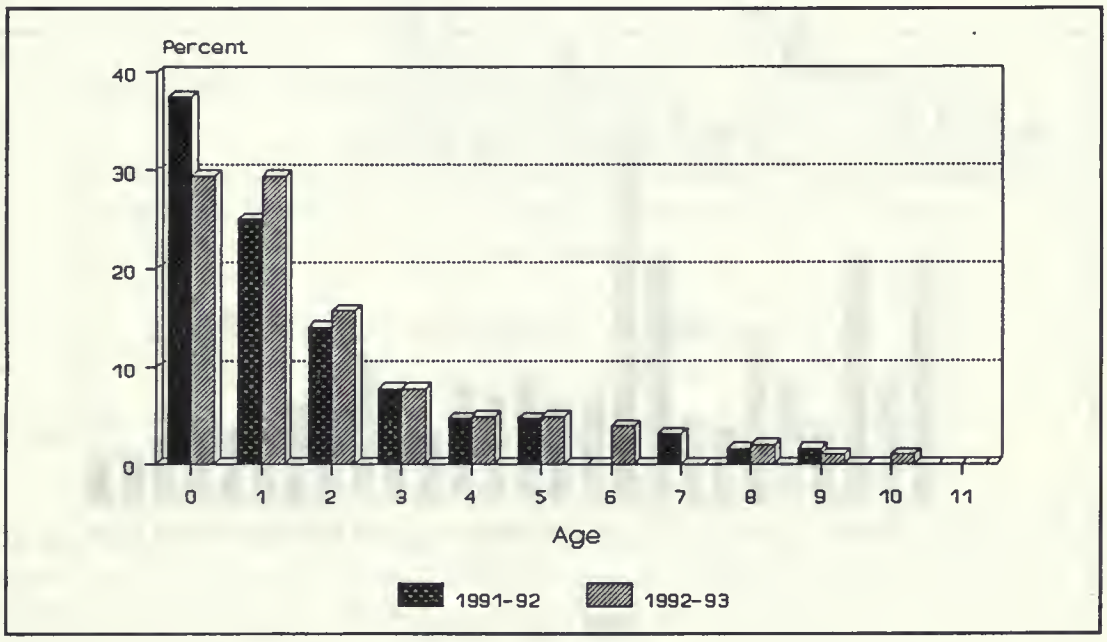


Figure 35. Comparison of bobcat age distributions for Region 2, 1991-92 and 1992-93.

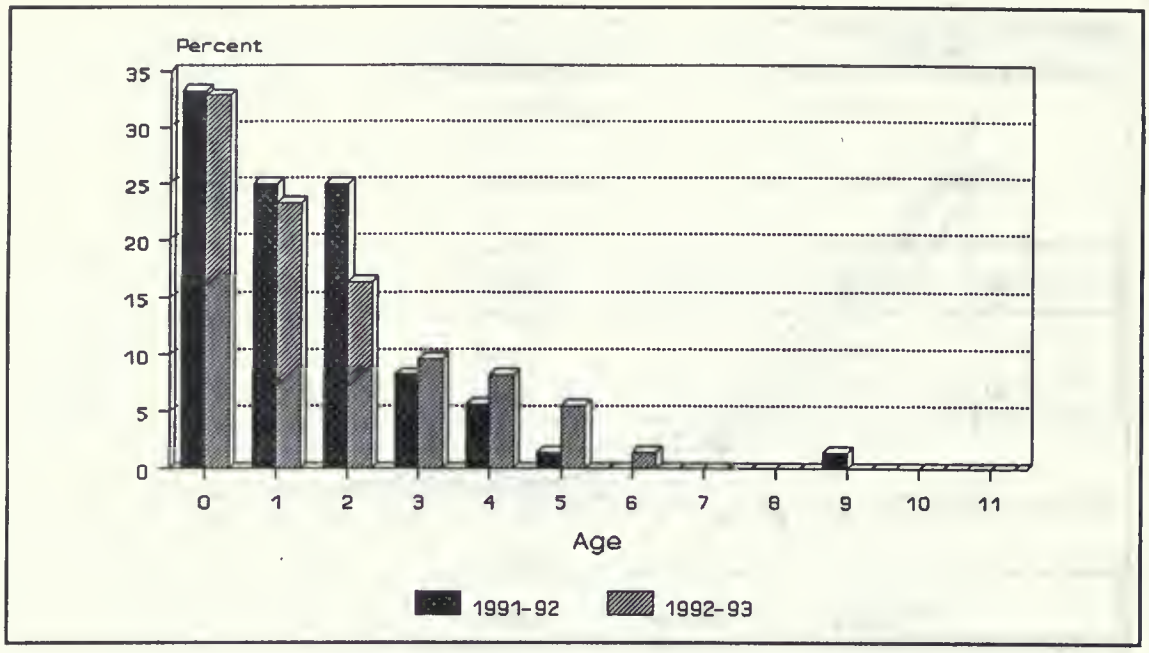


Figure 36. Comparison of bobcat age distributions for region 3, 1991-92 and 1992-93.

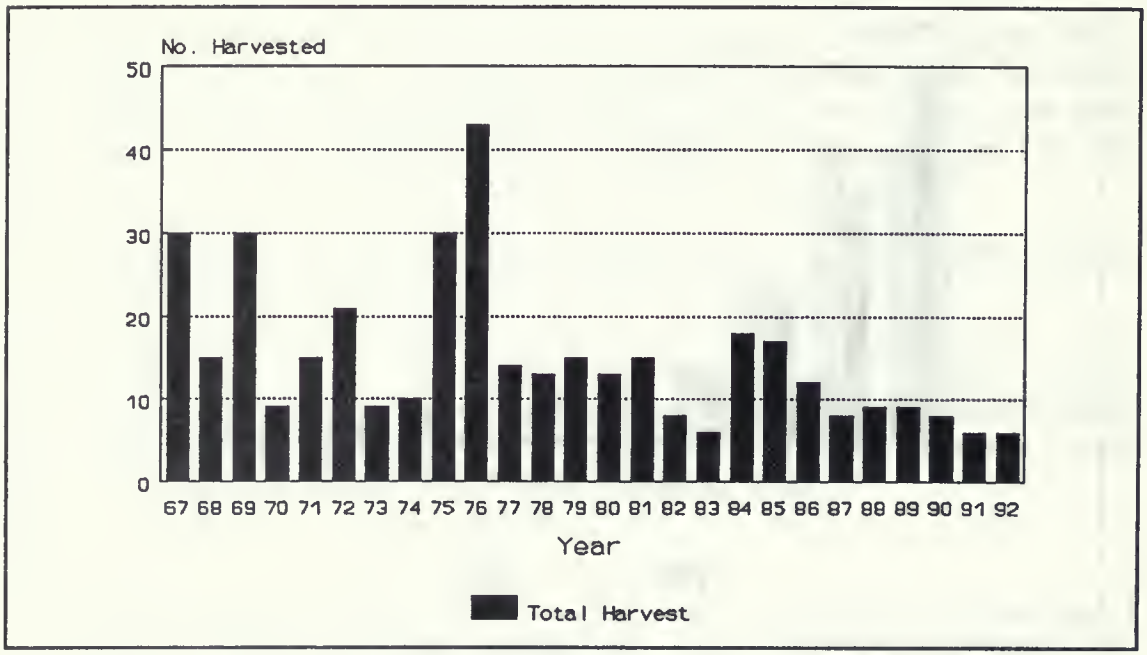


Figure 37. Annual wolverine harvests since 1967.

Wolverine have been harvested in 59 hunting districts and from within the Blackfeet Indian Reservation. Harvests have occurred in Regions 1, 2, 3, 4, 5, and 6 over the period from 1967-1993. Distribution maps of the harvest were prepared for the entire time period and the time period stratified by 10 year increments. Graphic displays of the distribution are being prepared but were not available for inclusion into this report.

Sex ratio of the harvest initially favored females; more recently males have comprised over 50% of the harvest (Fig. 38). There was a significant increase in the ratio of male to female wolverine (Chi-Square= 2.064, P=0.15) when comparing the time period 1974-83 with 1984-93.

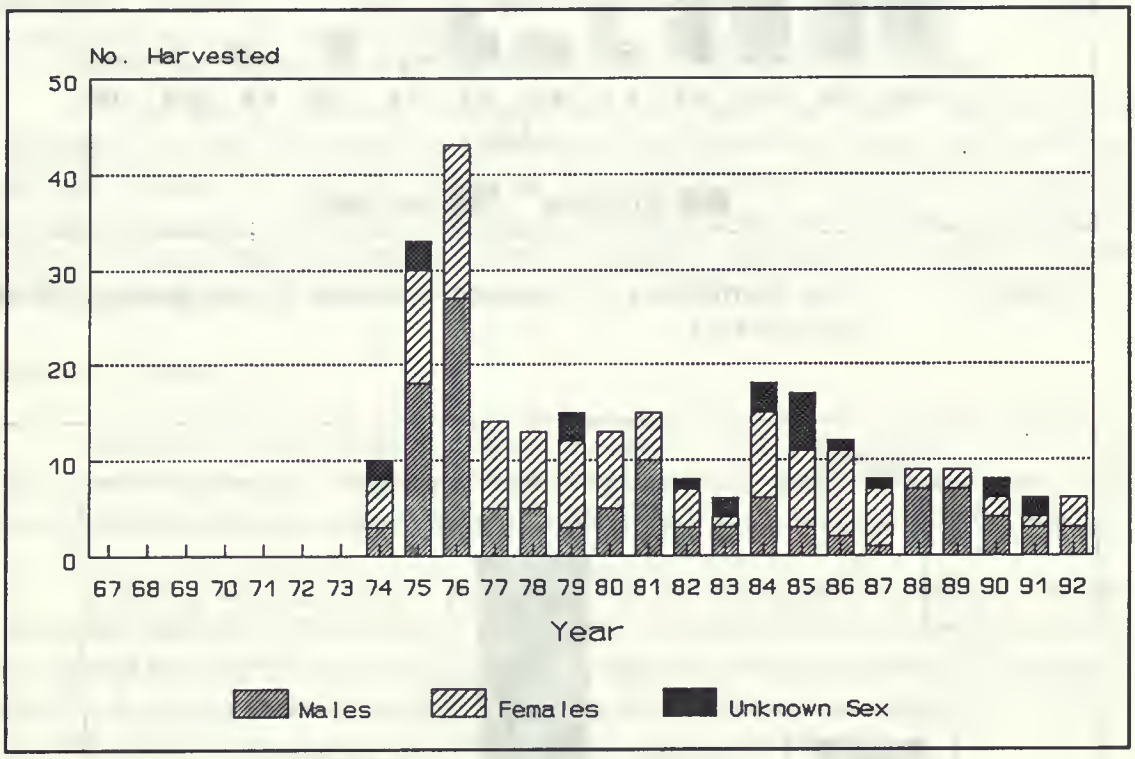


Figure 38. Sex ratio of the wolverine harvest since 1974.

There was little difference in the age distribution of wolverine harvested from 1974-83 compared to wolverine harvested from 1984-1993 (Fig. 39). The proportion of juveniles was 19.7% for the period 1974-1983 and 28.6% for the period 1984-1993. The mean age for these two periods were 2.34 and 2.27 years and did not differ significantly (t=0.226, P=0.822).

Fifteen gravid females were examined. The average number of fetuses was 2.7 (SD=1.2) and ranged from 1 to 5. Litters of 3 were most common (Fig. 40). Analysis of reproductive tracts is not complete, and results will be presented later.

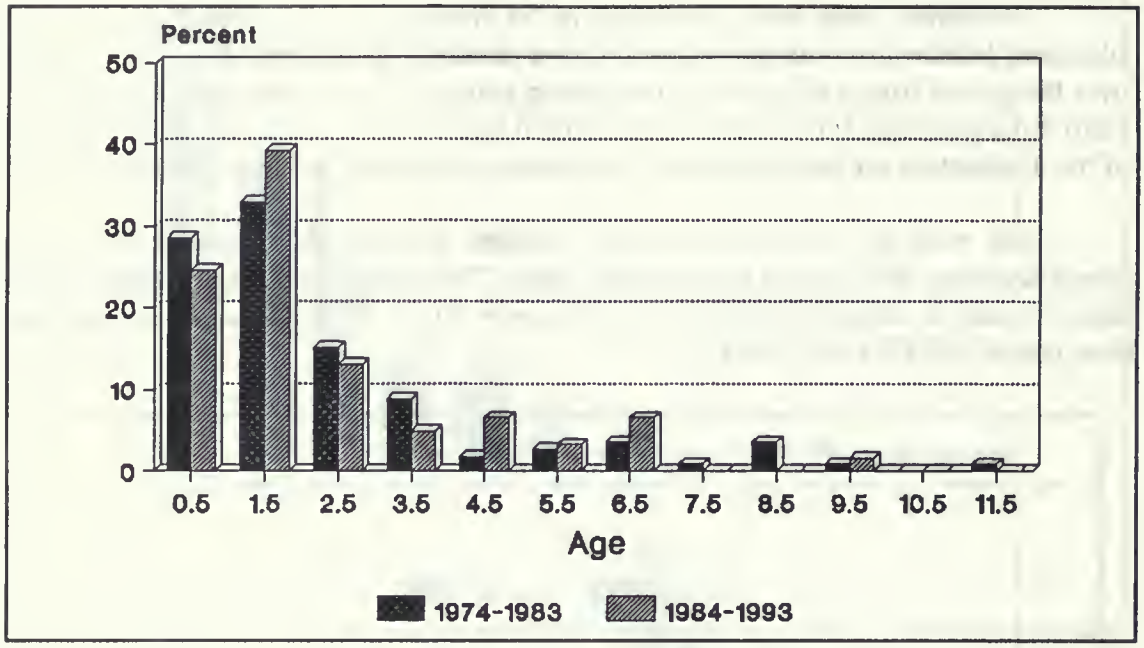


Figure 39. Age distributions of harvested wolverine for the periods 1974-83 and 1984-93.

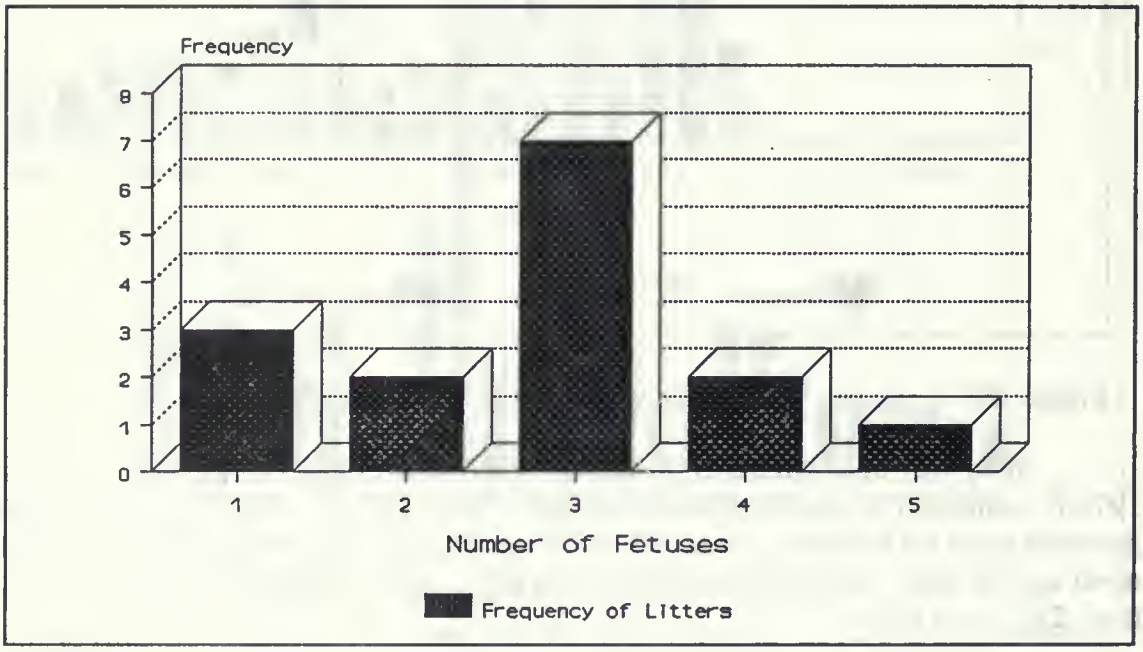


Figure 40. Frequency of wolverine litters by size.

Trichinella testing was conducted on 110 wolverine during this period. Positive test results were obtained from 75.5% of the samples. Larvae per gram ranged from 0 to 215. The proportion of males testing positive was 80.4% and females 68.6%. This difference was not significant (Chi-square= 1.97, df= 2, P=0.16). There did appear to be a difference in prevalence geographically with the prevalence declining from the northwestern to southeastern portions of Montana.

RECOMMENDATIONS

Wildlife laboratory services should continue. Sufficient flexibility should be maintained in order to be able to readily respond to changing needs of wildlife management and research biologists.

Efforts should continue to update computer data files from large raw data compilations so that information is more readily available to biologists and managers. Computer-assisted data analysis should be continued in order to publish and distribute data on many topics of interest including mountain lion harvest data, food habits, reproductive performance of selected species, diseases and parasites of selected wildlife, and blood profiles.

Furbearer Studies

Pine marten, fisher, lynx, and wolverine carcass collections should continue. The funding of this program, however, must continue to be specifically directed to the laboratory so that budgeting and manpower planning can be more easily conducted.

A bobcat skull collection process should be developed if additional regions participate in bobcat skull collections. The current situation results in many bobcat skulls with limited information as to sex, location of kill, date of kill, or name and address of trapper. A tagging process similar to that used for mountain lions should be considered to assure correct tagging and reference marking of each specimen.

Bear Studies

Field efforts should be continued on the Flying D Ranch to validate the monitoring techniques applied there, and to test the feasibility of using fecal nitrogen to monitor habitat conditions on a relative scale. Proposals for outside funding need to be written and submitted if internal sources of funding are not possible.

The establishment of a protocol for processing grizzly bear carcasses has the potential to greatly increase our knowledge of bears. All carcasses which can be reasonably obtained from the field should be immediately transported to the laboratory or frozen for later examination. A concerted effort by all regions involved will be necessary, and complete cooperation from field personnel will be essential. The potential

exists for functional anatomy study, and serious disease and parasitology studies with the materials available from the field.

Relocating grizzly bears to resolve human/bear conflict is frequently applied in both the Yellowstone and Northern Continental Divide Ecosystems. Record keeping in the NCDE is often unavailable for consistent review and analysis. It is recommended that copies of problem bear capture forms and interagency nuisance report forms from the NCDE be forwarded to the wildlife laboratory for filing and record keeping. Annual summaries of the information should be completed. This will provide accurate and long term record keeping of relocation efforts for review by grizzly bear managers.

Disease Surveillance

Cooperative programs for disease surveillance should be promoted. Field efforts should be implemented to collect tissue and blood from wildlife near TB infected game farms. Research projects handling captured wildlife should participate when possible in the statewide serological survey for microbial agents. A blood protocol is available from the laboratory and assistance in collection techniques can be obtained. Laboratory protocols should be developed to conduct routine fecal analysis and Baermans for parasite investigations in cooperation with the Veterinary Molecular Biology Parasitology Laboratory.

Mountain Lions

Laboratory budgets need to be increased to accommodate the larger work load assumed by the increasing lion harvest. Obtaining vacuum packaging equipment would reduce the need to clean skulls before shipping, and enhance the speed and the quality of the processing of lion skulls belonging to sportsmen.

The mountain lion trophy form has been modified to include a copy forwarded to the wildlife laboratory. This has proven successful and should continue with one modification. The hunters telephone number should be recorded on the form so that contact with the sportsman can be facilitated.

Mountain lions continue to be a source of conflict in some areas of Montana. The significant increase in lion problems may be assisted or exacerbated by hunting programs. Some scientists theorize that increased removal of older aged lions could destabilize populations. It is not known if the observed removal of older aged animals in Region 1 and the recent dramatic increase in lion conflicts could be linked.

Increased populations of white-tailed deer are also suggested to be a factor causing more mountain lions (Riley 1993). In some areas where white-tailed deer are increasing and mule deer are stable or declining, a shift in lion distribution to better hunting areas could explain the sightings and increased conflicts with lions in populated areas such as

the Flathead Valley. Controlling white-tailed deer populations may provide the best method to reduce lion intrusions into suburban type areas of Montana.

Neither of the problems discussed can be adequately resolved by simply increasing the lion harvest through liberal quotas. The heart of the solution may lie in increasing the harvest in areas where lions are not compatible and creating a stable harvest in areas where populations of lions are compatible. Creating a zoned hunting program to target removal of potential problem lions could assist in directing harvests. Special zones where mountain lions are not compatible with increased human populations should be established with liberal general and special season regulations.

LITERATURE CITED

Aune, K. E. 1991. Increasing mountain lion populations and human-mountain lion interactions in Montana. Pages 86-94 *in* Human-Mountain Lion Interactions Symposium and Workshop, Denver, Colo. 114 pp.

Aune, K. E., and P. Schladweiler. 1991. Wildlife laboratory annual report. November 1991. Montana Dept. of Fish, Wildl. and Parks. Helena, MT. 52 pp.

Aune, K. E., and P. Schladweiler. 1992. Wildlife laboratory annual report. November 1992. Montana Dept. of Fish, Wildl. and Parks. Helena, MT. 49 pp.

Craighead, J. J., K. Greer, R. Knight, and H. I. Pac. 1988. Grizzly bear mortalities in the Yellowstone ecosystem. Interagency Grizzly Bear Study Team. Bozeman, Mont. 102 pp.

Dood, A., and H. Pac. In Press. Grizzly bear mortality studies in the conterminous 48 states - January 1, 1991-December 31, 1992. Research Progress Report. Research and Technical Services Bureau, Wildlife Division, Montana Dept. of Fish, Wildlife and Parks.

Douglas, C. W., and M. A. Strickland. 1987. Fisher. Pp. 510-529 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch, eds. Wild Furbearer Management and Conservation in North America. Ontario Trappers' Assoc., North Bay. 1150 pp.

Greer, K. (Unpublished data). Aging of mountain lions by skull suture characteristics. Wildlife Laboratory. Montana Dept. of Fish, Wildlife and Parks, Bozeman.

Knight, R. R., B. M. Blanchard, and D. J. Mattson. 1993. Yellowstone grizzly bear investigations: annual report of the Interagency Study Team, 1992, U.S. Natl. Park Serv. 26 pp.

Nagorsen, D. W., J. Forsberg, and G. R. Giannico. 1988. An evaluation of canine radiographs for sexing and aging Pacific coast martens. Wildl. Soc. Bull. 16 (4): 421-426.

Pac, H. I., and K. Frey. 1991. Some population characteristics of the northern Yellowstone bison herd during the winter of 1988-1989. Mt. Dept. of Fish, Wildl. and Parks, Helena, MT. 29 pp.

Riley, S. J. 1993. Cougars in Montana: A review of biology and management and a plan for the future. Mont. Dept. of Fish, Wildlife and Parks, Helena, MT. 39pp.

Seesee, F. M., D. E. Worley, and T. E. Weiss. 1991. Helminths of the mountain lion, *Felis concolor*, in Montana. Veterinary Molecular Biology, Montana State Univ., Bozeman. Abstract only.

Strickland, M. A., and C. W. Douglas. 1987. Marten: Pages 530-545 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch, eds. Wild furbearer management and conservation in North America. 1150 pp.

Trainer, C. E., and G. Matson. 1988. Age determination in cougar from cementum annuli counts of tooth sections - A progress report. Pp. __ *in* Third Mountain Lion Workshop, December 1988. Prescott, Arizona. __ pp.

Wood, A. K., R. E. Short, A. E. Darling, G. L. Dusek, R. G. Sasser, and C. A. Ruder. 1986. Serum assays for detecting pregnancy in mule and white-tailed deer. J. Wildl. Manage. 50(4): 684-687.

Appendix A

ANNUAL REPORT

BEAR TRICHINOSIS TESTING PROGRAM

1993 SUMMARY

Veterinary Molecular Biology Laboratory
Montana State University
March 1994

Muscle samples from 95 hunter-killed black bears were submitted for *Trichinella* testing in 1993. Forty bears were examined during the spring season, with 55 additional animals screened during the fall hunting season. Overall, 14 bears (14.7%) were positive for encysted muscle larvae (Table 1). Larval tissue concentrations averaged 41.6 larvae per gram of muscle (LPG) and ranged from 0.08-323.6 LPG. Ten of the 14 infected bears were males.

The geographic distribution of infected bears was concentrated in a contiguous five-county area in northwestern Montana located between the Bitterroot Range on the Idaho border east to the Continental Divide (Fig. 1). Lake County had the highest prevalence (100%), followed by Mineral and Sanders (50%), Flathead (26.6%), and Lincoln Counties (14.3%). Occurrence of infected bears was similar to the 1992 distribution and coincides with the region where the major bear harvest occurs in the state. The only positive animals originating outside Region 1 were taken on the West Fork of the Bitterroot drainage in southwestern Ravalli County and in hunting district 201 in the lower Clark Fork drainage west of Missoula.

Bear muscle samples were submitted for testing from 18 counties in 1993. The largest number of specimens was received from Flathead County hunters (17.8% of total), followed by Lincoln (11.6%), Sanders (10.5%), Sweet Grass (7.4%), and Missoula Counties (6.3%). Approximately 42% of the samples were submitted during the spring season vs. 58% in the fall. However, as in most previous years, a greater proportion of spring-killed bears were positive (20.5%+) compared with 10.9%+ in the fall. No obvious biological explanation exists for this seasonal trend, which has occurred in 5 of the past 6 years (Table 2).

The number of hunters submitting bear meat for testing in 1993 was up about 2% from the previous year. Use of special mailing kits distributed by MDFWP Regional Offices, County Extension Service offices and sporting goods stores probably contributed to hunter participation in the testing program. Availability of an educational brochure designed to acquaint hunters with ursine trichinosis and its transmission to humans also may have added to the record number of samples received. Essentially all hunters submitting meat for testing indicated that the carcass would be used for human consumption. With the changes in bear hunting regulations currently under consideration, the importance of continuing both hunter education and the free testing program is apparent.

David E. Worley
Floyd M. Seesee
Keith Aune

B.C.
MONT.
IDAHO
To Spokane, 132 miles
To Spokane, 111 miles
To Spokane, 83 miles
To Lewiston, 176 miles
Roosville
Port of Roosville
Eureka
Rexford
Yaak
Troy
Libby
Kootenai
Lake Koocanusa
Fortine
Trego
Stryker
Olney
Whitefish
Columbia Falls
Kalispell
Marion
Happy Inn
Heron
Noxon
Trout Creek
Thompson Falls
Belknap
Murray
Prichard
Delta
Burke
Gem
Mullan
Wallace
Saltese
De Borgia
Haugan
Avery
St. Regis
Superior
Plains
Paradise
Perma
Dixon
Ravalli
Arlee
Stark
Alberton
Huson
Frenchtown
Missoula
Milltown
Bonner
Potomac
Clinton
Lolo
Lolo Hot Springs
Florence
Stevensville
Fort Owen
Darby
Conner
Sula
Anaconda
Deer Lodge
Opportunity
Walkerville
Rocker
Warm Springs
Garrison
Drummond
Hall
Bearmouth
Helmville
Ovando
Seeley Lake
Lincoln
Helena
Augusta
Avon
Elliston
Goldcreek
Pioneer
Garnet
Greenough
Maxville
Potomac
Clinton
Bonner
Milltown
Ronan
Pablo
St. Ignatius
Charlo
Moiese
Polson
Big Arm
Dayton
Elmo
Niarada
Hot Springs
Camas
Lakeside
Bigfork
Creston
Columbia Heights
Coram
Martin City
West Glacier
Hungry Horse
Essex
Swan Lake
Babb
Chief Mtn.
Carway
Port of Chief Mtn.
Port of Piegan
Port of Del Bonita
Del Bonita
Waterton Park
Flathead
Kiowa
Browning
East Glacier Park
Heart Butte
Dupuyer
Augusta
Gibson Dam
Bob Marshall Wilderness
Great Bear Wilderness
Mission Mts. Wilderness
Scapegoat Mt. El. 9165
Lake Inc.
Lake Alice
Lake Mary Ronan
Flathead Lake
Swan Lake
Seeley Lake
Ovando
Helena
Lincoln
Deer Lodge
Anaconda
Darby
Sula
Sula State Forest
Lolo Pass El. 5235
Lolo Hot Springs
Lolo Peak El. 9127
Lookout Pass
Saltese
Lookout Peak El. 6840
Hidden Peak
Diablo Peak El. 7465
Sawtooth Wilderness
Bitterroot Wilderness
Mt. Haggin El. 10635
Mt. Haggin El. 10590
Short Peak El. 10240
Grassy Mtn. El. 7900
Fish Peak El. 10240
Trapper Peak El. 10157
Shook Mtn. El. 7551
Sula State Forest
Lake Lemon
Sleeping Child Hot Springs
Deer Lodge Pass El. 5908
Deer Lodge Pass El. 5900
Cleveland Mtn. El. 7182
Lee Metcalf National Wildlife Refuge

Table 1. Summary of *Trichinella* Infection Levels in Black Bears Taken During Spring and Fall Hunting Seasons, 1993

ACCESSION NO.	DATE OF KILL	SEX	KILL SITE	TISSUE EXAMINED	INFECTION INTENSITY (LPG)*
145-93	6 May 93	♂	Canyon Creek, Lincoln Co. (H.D. 103)	Tongue	10.9
147-93	7 May 93	♂	West Fork of Bitter-root Drainage, Ravalli Co. (H.D. 250)	Tongue	323.6
153-93	13 May 93	♂	Cilly Creek, Lake Co. (H.D. 132)	Tongue	1.3
163-93	19 May 93	♂	Squeezer Creek, Swan Drainage, Lake Co. (H.D. 130)	Tongue	1.3
164-93	19 May 93	♂	Flat Creek, Flathead Co. (H.D. 140	Skeletal Muscle	60.3
166-93	21 May 93	♂	Thompson River Drainage, Sanders Co. (H.D. 122)	Tongue	0.1
167-93	25 May 93	♂	Hay Creek Drainage, Flathead Co. (H.D. 110)	Tongue	50.9
180-93	10 Jun 93	♂	Paint Creek Drainage, S. Fork of Flathead River, Flathead Co. (H.D. 140)	Tongue	1.0
194-93	15 Sept 93	♀	East Fork of Bull River, Berray Mtn., Sanders Co.	Tongue	0.08
196-93	19 Sept 93	♀	Silver Bow Pass, Sanders Co. (H.D. 104)	Tongue	14.8
220-93	26 Sept 93	♂	Big Creek Drainage, North Fork of Flathead River, Flathead Co. (H.D. 110)	Tongue	111.8
260-93	10 Oct 93	♀	Deep Creek Drainage, Sanders Co.	Skeletal Muscle	1.2
283-93	17 Oct 93	♂	Shaw Gulch, Mineral Co. (H.D. 201)	Tongue	5.1
284-93	16 Oct 93	♀	Compass Creek Drainage, Sanders Co. (H.D. 122)	Tongue	0.8

*Expressed as *Trichinella* Larvae/gram of muscle tissue
Mean *Trichinella* LPG=41.6
(Range 0.08-323.6)

Table 2. Seasonal Prevalence of *Trichinella*-Infected Black Bears in Montana (1988-93)

	Hunting Season	
Year	Spring*	Fall*
1988	25.0%	21.5%
1989	26.9%	15.0%
1990	20.0%	5.3%
1991	9.7%	3.8%
1992	6.3%	7.1%
1993	20.5%	10.9%

* Indicates proportion of infected bears among total number examined.

Appendix B

SURVEILLANCE FOR BOVINE TUBERCULOSIS IN FREE-RANGING, WILD CERVID POPULATIONS IN THE WESTERN UNITED STATES

PRESENTED TO THE WILDLIFE COMMITTEE
UNITED STATES ANIMAL HEALTH ASSOCIATION
LAS VEGAS, NEVADA
OCTOBER, 1993

BY

ROBERT M. MEYER
TUBERCULOSIS EPIDEMIOLOGIST
VETERINARY SERVICES - WESTERN REGION

Historically, only four cases of bovine tuberculosis have ever been described in free-ranging, wild animals in the United States. And today, this disease is not known to exist in our wild animal populations. However, since 1991, several outbreaks of bovine tuberculosis in captive deer and elk herds throughout the United States have been reported. As a result, some concerns exist that, under certain conditions, bovine tuberculosis might escape and establish a reservoir in our large populations of wild cervidae located in the western United States.

During the past few years, hunter-kill surveys have been organized by State game and fish personnel, animal health officials, and laboratory diagnosticians in Montana, Wyoming, and Colorado in an effort to confirm that bovine tuberculosis has not been transmitted to wild cervids from infected, captive cervid herds or from domestic herds of cattle . The following three State reports provide a preliminary summary of surveillance activities conducted to date.

MONTANA TB SURVEILLANCE ACTIVITIES

Prepared by K. E. Aune, Montana Dept. of Fish, Wildlife, & Parks; Bozeman, MT; J. C. Rhyan, National Veterinary Services Laboratory, Ames, IA.

Introduction

The diagnosis of tuberculosis caused by Mycobacterium bovis in captive elk near Corwin Springs, Montana in 1990 sparked concern that the disease might escape into wild elk wintering nearby or migrating through the area. These infected, captive elk were located in a game farm near the northern boundary of Yellowstone National Park on winter habitat for 15,000-18,000 wild elk. The close proximity of large numbers of wintering elk to TB infected game farm elk raised considerable concern among animal health and wildlife officials in Montana (Ferlicka 1991).

Methods

In 1991 the Montana Department of Fish, Wildlife and Parks (MDFWP) in cooperation with the National Veterinary Services Laboratory (NVSL) and the Montana Veterinary Diagnostic Laboratory began a surveillance program to evaluate the prevalence of various diseases and parasites in Montana elk near Yellowstone National Park. Three herd groups were sampled including: 1) Approximately 15,000 elk wintering on the upper Yellowstone River near Yellowstone National Park; 2) 2,500 elk wintering on the Flying D Ranch in the lower Gallatin River Canyon; and 3) 2,500 elk wintering on the Sun Ranch

in the upper Madison River. The northern herd is composed of migrant elk that summer within Yellowstone National Park. The elk herd on the Sun Ranch is composed of 50% migrants from Yellowstone National Park and 50% resident elk summering in the upper Madison. The Flying D elk are mostly resident elk from the lower Gallatin Canyon and associate very little with elk from Yellowstone National Park.

Specimens were collected from hunter-killed elk during or just after field dressing. A complete set of field specimens consisted of whole and heparinized blood samples, approximately 200 grams of feces, any tissues with observable lesions, mammary glands, supramammary lymph nodes, uterus or placentomes, amniotic fluid, liver (including hepatic lymph nodes), mesenteric lymph nodes, kidney, distal ileum, trachea, lungs (including mediastinal and tracheobronchial lymph nodes), heart, and head. Field specimens were taken to the MDFWP Research Laboratory in Bozeman, Montana, where tissues were examined and trimmed. Half of each tissue specimen was frozen and half fixed in 10% neutral buffered formalin. Frozen and fixed tissues were submitted to the NVSL for histopathologic and bacteriologic examination. Fecal specimens were split with one sample submitted to NVSL for Mycobacterium paratuberculosis culture and the other examined at Montana Veterinary Molecular Biology for Dictyocaulus spp. Serology was conducted at the Montana Veterinary Diagnostic Laboratory.

Summary of Results

Complete or partial sets of specimens were collected from 189 elk in 1991-92 and 68 in 1992-93. Specimens were collected from 141 elk in the northern range, 52 elk from the Flying D Ranch, and 64 elk from the Madison.

Several gross lesions were noted including tonsillar abscesses, pulmonary abscesses, small lymph node granulomas, and liver lesions. Tuberculous lesions were not evident in lung tissue examined grossly.

The histopathologic examination of tissue from 1991-92 is completed. Mycobacterial lesions were not observed. Other incidental findings included tonsillar abscesses, eosinophilic lymphadentits, sarcocytosis, purulent lymphadenitis, eosinophilic interstitial pneumonia, and a purulent bronchopneumonia. Tissue from 1992-93 is currently being examined, and results are pending. Neither Mycobacterium bovis or Mycobacterium paratuberculosis was isolated from any of the tissues cultured. Mycobacterium avium was cultured from one lung specimen. Pasteurella multocida and Actinomyces pyogenes were cultured from one pneumonic, abscessed lung.

Future Monitoring

Montana has over 1.5 million wild cervids scattered throughout a land mass encompassing 150,000 square miles. The diverse wildlife communities distributed throughout this large land mass hinder broad surveillance programs for tuberculosis. Surveillance for tuberculosis in wild cervids will primarily be attempted in selected regions where the highest probability of transmission from captive wildlife may be expected. Future or current outbreaks of tuberculosis in game farms will initiate cooperative surveillance attempts in wildlife for at least 2 years following initial diagnosis. Additionally, all suspect mortalities that are detected opportunistically throughout the State will be subject to post mortem examination.

Informational efforts will also be implemented to alert the hunting public about the possibility of encountering diseased animals. Hunters are being asked to report lung lesions to wildlife officials in areas near tuberculosis infected captive cervids. Recently improved game farm rules and regulations with health certification requirements are being implemented in Montana, and will insure better monitoring of infectious disease in game farms throughout the State.

Conclusions

Preliminary evidence suggests that TB has not escaped from game farm animals in south-central Montana. Specific surveillance of wildlife near infected game farms and routine necropsy of all suspect deaths of wildlife have not identified mycobacterial lesions or active infections. However, continued selective surveillance based on histopathology and bacteriology is recommended.

The cervid game farm industry in Montana grew faster than the government's ability to regulate it (Ferlicka, 1991). At this time, it appears that the most likely source of tuberculosis transmission to free ranging wildlife would be either native or exotic, captive cervids (Thorne, 1991). Montana's immense wild cervid resources must be protected from tuberculosis through proper regulation and monitoring of game farmed cervids. The primary defense against TB escaping into wild cervids is rapid control and eradication of the disease in captive cervids.

The diagnostic tests used for TB are subject to question and even ridicule by the public (Ferlicka, 1991). The commonly adopted standard skin tests (single cervical or comparative cervical) require manageable animals and complex handling facilities (Haigh, 1991). Broad surveillance for TB in wild cervids is nearly unfeasible because of the limited testing options and handling requirements. Rapid serum tests (ELISA) for elk, deer, and other cervids need to be better developed before broad surveillance can be better adapted for wild, free ranging wildlife.

Literature Cited

Ferlicka, D. P. 1991. Captive Cervid Tuberculosis and Concerns of the State Veterinarian. *Bovine Tuberculosis in Cervidae: Proceedings of a Symposium*. July, 1991. Denver, Colorado.

Haigh, J. C. 1991. Practical Considerations for Tuberculin Testing in Cervids. *Bovine Tuberculosis in Cervidae: Proceedings of a Symposium*. July, 1991. Denver, Colorado.

Thorne, E. T., M. W. Miller, D. L. Hunter, and E. S. Williams 1991. Wildlife Management Agency Concerns About Bovine Tuberculosis in Captive Cervidae. *Bovine Tuberculosis in Cervidae: Proceedings of a Symposium*. July, 1991. Denver, Colorado.

WYOMING TB SURVEILLANCE ACTIVITIES

Prepared by R. M. Meyer, USDA, APHIS, VS, Englewood, CO; E. S. Williams, Wyoming State Veterinary Lab., Laramie, WY; D. Woody, USDA, APHIS, VS, Afton, WY; S. Smith, Wyoming Game and Fish Dept., Pinedale, WY; F. Enos, USDA, APHIS, VS, Lander, WY; E. T. Thorne, Wyoming Game and Fish Dept., Laramie, WY;.

During the fall of 1992, the Wyoming Game and Fish Department in cooperation with USDA, APHIS, Veterinary Services, the Wyoming State Veterinary Laboratory, and the Wyoming State Veterinarian's office, organized a pilot project to survey hunter-killed elk for bovine tuberculosis near Jackson, Wyoming. The primary objective of this initial, pilot survey was to evaluate the feasibility of collecting tissues from hunter-killed elk of the Jackson herd unit as they migrated south from Yellowstone National Park and vicinity toward winter range on the National Elk Refuge near Jackson, and during special hunts located on the refuge itself. 8,000 - 10,000 elk typically winter on the National Elk Refuge each year.

Emphasis was placed on collecting lymphatic tissues from heads at the time animals were loaded onto vehicles near accessible roads, or at nearby hunter check stations. Traceback to the viscera of field-dressed animals to examine and collect lung tissue, mediastinal, tracheobronchial, hepatic, or mesenteric lymph nodes was to be attempted only if it could be accomplished safely and if applicable regulations permitted.

Lymphatic tissues were collected from the heads of 123 elk. The tissues were examined grossly, fixed in 10% neutral buffered formalin, and forwarded to the Wyoming State Veterinary Laboratory in Laramie, Wyoming, for further microscopic examination. Lung, mediastinal, tracheobronchial, or hepatic lymph nodes were also examined in 3 elk. Duplicate samples of each tissue were identified and placed in plastic bags for freezing. Survey protocol provided for the forwarding of these frozen tissues to the National Veterinary Services Laboratory for bacteriologic examination in case lesions suspicious of tuberculosis were noticed during histopathologic examination. Hematoxylin and eosin staining was used routinely; acid-fast stains were used on all tissues with abscesses or pyogranulomas. No gross or microscopic evidence of tuberculosis has been disclosed in any tissue examined to date.

Based upon the general success of the 1992 pilot project, plans have now been formulated to further expand the tuberculosis surveillance project in elk during the 1993 hunting season. More personnel have been committed to collect tissues during the elk hunts on or near the National Elk Refuge which should result in greater numbers of tissues being collected. Cervical lymph nodes taken from the heads of elk processed at local abattoirs will also be collected for examination.

COLORADO TB SURVEILLANCE ACTIVITIES

Prepared by M. W. Miller, Colorado Division of Wildlife, Ft. Collins, CO; C. W. McCarty, Colorado Division of Wildlife, Ft. Collins, CO; E. S. Williams, Wyoming State Veterinary Lab., Laramie, WY.

Bovine tuberculosis was diagnosed in captive elk held on a game ranch near Powderhorn, Colorado in June 1991. Since that time, the Colorado Division of Wildlife has continued to investigate the possibility that tuberculosis might have spread to free-ranging wildlife outside the infected premises.

During October 1992-January 1993, retropharyngeal and other cranial lymph nodes and tonsils from about 80 mule deer and elk harvested in the Powderhorn vicinity (GMUs 66 and 67; DAU D25/E25) were examined for gross lesions of bovine tuberculosis. For comparison, we also examined these tissues from about 67 mule deer and 32 elk harvested on the Forbes Trinchera Ranch (DAU D31/E33) and about 25 mule deer and 29 elk harvested along the northern Front Range (GMUs 19 and 20, DAUs D4, D10/E4, E9).

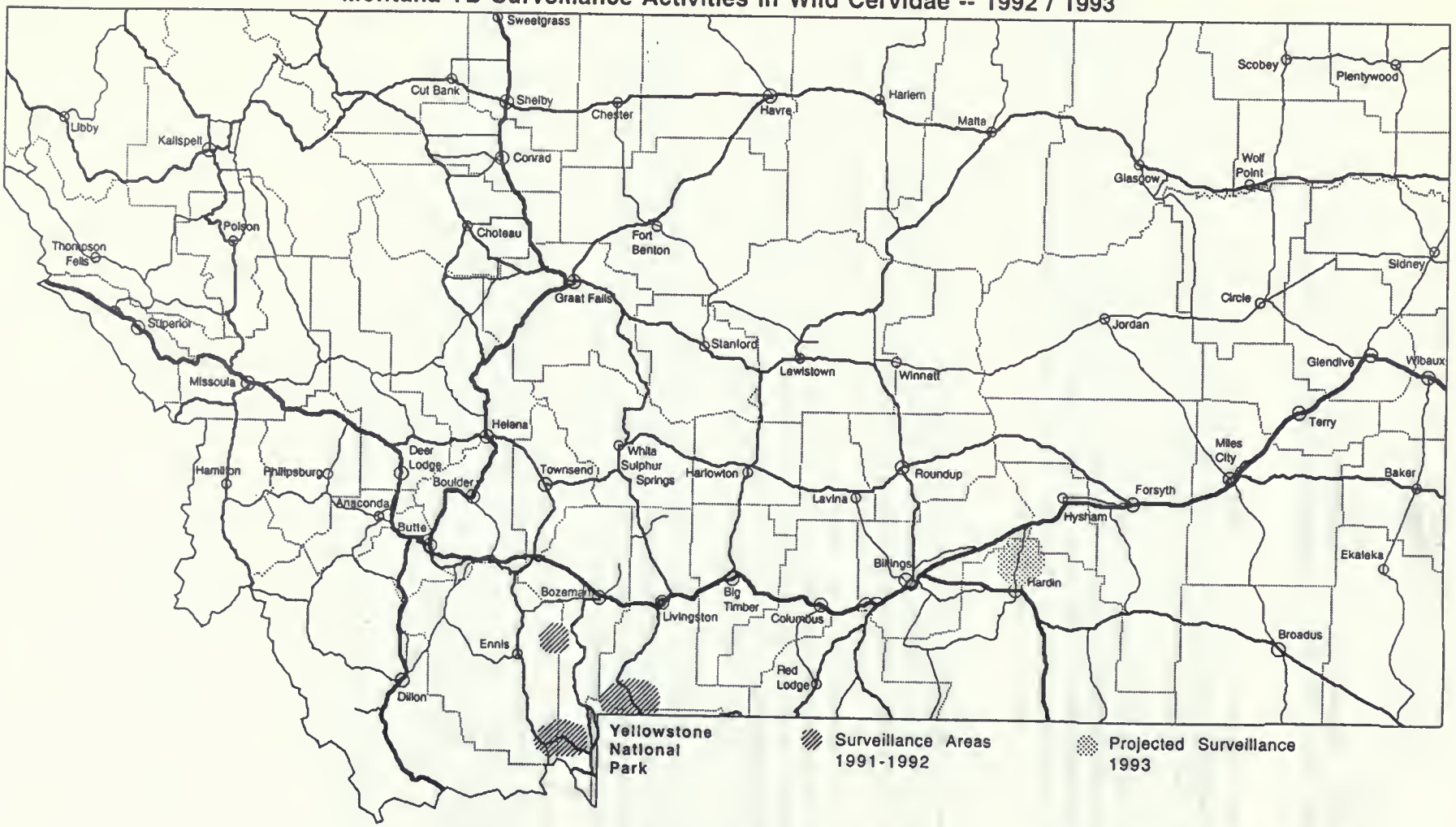
Representative sub-samples of parotid, mandibular, and retropharyngeal lymph nodes and tonsils, as available, were preserved in 10% buffered formalin and frozen at -20 C. Fixed tissues were submitted to the Wyoming State Veterinary Laboratory in Laramie for histologic examination (to be followed up with culturing, when warranted). Samples were collected by field officers and from game processors. When possible, eviscerated carcasses were also examined for gross lesions suggestive of tuberculosis. In addition to tissue collections, we received 79 serum samples from hunter-killed deer and elk from GMUs 66 and 67 through our annual mail-in survey. Those samples, as well as sera from 1991, are stored at -20 C pending screening with an enzyme-linked immunosorbent assay (ELISA) for bovine tuberculosis developed at Colorado State University in Ft. Collins.

In about 17 of more than 200 harvested deer and elk examined from select areas, we observed tonsillar and/or retropharyngeal cysts, abscesses, and/or granulomas; all 3 sampling areas yielded such cases. Histologic evaluations have not been completed, but no microscopic lesions compatible with bovine tuberculosis have been observed in samples examined to date.

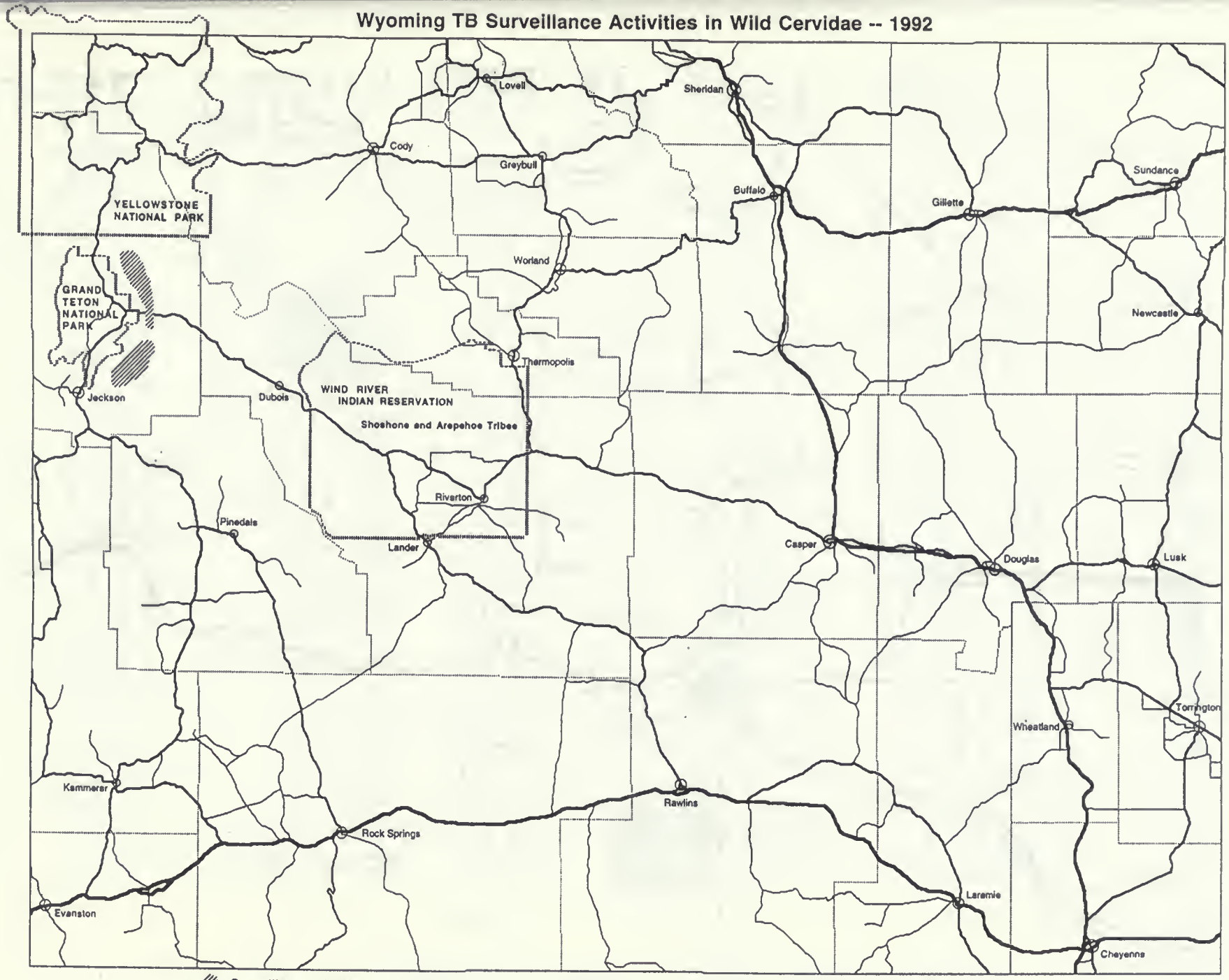
Examinations of wild deer and elk collected or harvested in the immediate vicinity of the tuberculosis-infected game ranch near Powderhorn since surveillance began in 1991 have revealed no indication of infection in free-ranging animals. However, sample sizes are still somewhat small (about 100), and thus the probability of failing to detect infection is relatively high (e.g., ≥ 0.6 if prevalence is $\leq 0.5\%$). Consequently, we plan to continue developing and refining our ongoing sampling program for deer and elk populations in the Powderhorn area and other select locations during FY 1993-1994.

This program will be used to continue tuberculosis surveillance, and may also be used in other areas of Colorado where potentially serious disease problems are diagnosed.

Montana TB Surveillance Activities in Wild Cervidae -- 1992 / 1993

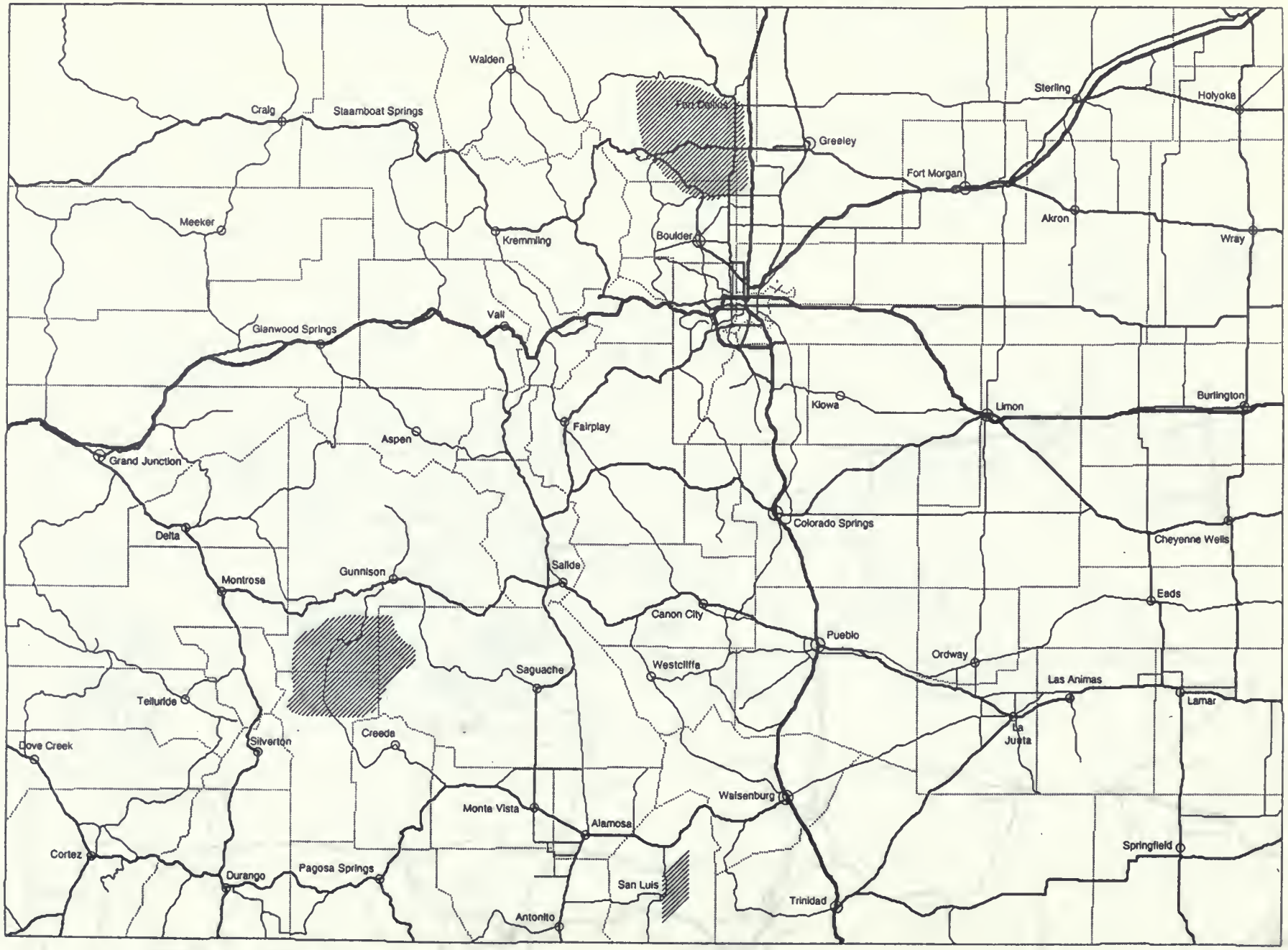


Wyoming TB Surveillance Activities in Wild Cervidae -- 1992



Surveillance Areas

Colorado TB Surveillance Activities in Cervidae -- 1992 / 1993



APPENDIX C DISEASE SURVEILLANCE RELATED TO BLACK-FOOTED FERRET (*MUSTELA NIGRIPES*) REINTRODUCTION

Philip Schladweiler and Ronald P. Stoneberg

Diseases have the potential to significantly impact many wildlife populations. Disease has played an important role in the management and reintroduction of black-footed ferrets to the wild (Williams et al. 1988). The Black-footed Ferret Disease Ecology Workshop, held in Oakland, California on 14 November 1992 recommended (among other things) that "two disease surveys should be performed on prairie dog towns scheduled for black-footed ferret reintroduction prior to reintroduction. The main focus for these surveys should be for active canine distemper and carnivore plague titers. Other disease hazards should also be evaluated during surveys."

Canine distemper is important because it is generally fatal in ferrets (Thorne et al. 1982:12). Plague is a flea-transmitted disease of rodents caused by the bacterium *Yersinia pestis*. Plague has been identified as the cause of major die-offs of prairie dogs (*Cynomys* spp.), the ferrets' primary food source (Barnes 1982). Prairie dog mortality may approach 100% in many cases. More recent evidence suggests that black-footed ferrets may also be directly susceptible to this pathogen (Thorne, pers. comm.).

Non-felid predators are largely resistant to, but produce antibodies against, plague (Barnes 1982). Therefore, serologic surveys of carnivores have been used to track plague activity on black-footed ferret reintroduction sites (Williams et al. 1992).

An apparently sudden, and in many cases total, disappearance of prairie dogs from several prairie dog towns within Montana's ferret reintroduction area occurred in summer 1992. This loss of prairie dogs was suggestive of a plague outbreak. However, fluorescent antibody staining techniques failed to detect plague among fleas or prairie dog remains collected on some of these dog towns.

To determine the presence of plague, and whether canine distemper was currently active in Montana's primary ferret reintroduction area, sampling of carnivores (primarily coyotes [*Canis latrans*]) that share these diseases with ferrets was undertaken. A secondary objective of this sampling was to survey these animals for a variety of other diseases and parasites that might affect ferrets, as well as to obtain baseline data on these diseases among local carnivores.

Material and Methods

U.S. Department of Agriculture Animal and Plant Health Inspection Service, Animal Damage Control (APHIS, ADC) personnel used a helicopter to collect 53 coyotes in south Phillips County on 19-20 January 1993. Montana Department of Fish, Wildlife and Parks (MDFWP) and Charles M. Russell National Wildlife Refuge (CMRNWR)

biologists provided ground support. ADC and MDFWP personnel collected an additional 29 coyotes and 3 red fox (*Vulpes vulpes*) from the Fort Belknap Indian Reservation on 26-27 January 1993.

Carcasses were tagged with an identification number in the field as they were collected, and brought to the ground crew within two hours of death. The ground crew recorded the tag number and sex of each animal, and collected blood from the thoracic cavity into sterile glass tubes, which were labeled and set aside to cool. Blood samples were centrifuged after collections for the day were over, and the serum was poured into separate tubes, labeled and frozen until tested.

A Nobuto strip (Wolff and Hudson 1974) was dipped into the blood in the thoracic cavity, labeled and air dried. Each carcass was put in a large plastic bag and left outside to cool. They were transported to Bozeman within two days and stored in the wildlife lab freezer.

The wildlife lab submitted serum samples to the Wyoming State Veterinary Laboratory for testing. Serologic tests and antibody titer levels used to determine prior exposure to plague, canine distemper, tularemia, toxoplasmosis, and five serovars of leptospirosis are as reported by Williams et al. (1992) with one exception. The antibody titer level considered indicative of exposure to canine distemper was $\geq$ 1:16 rather than $\geq$ 1:8 used by Williams et al. (1992).

Nobuto strips were submitted to the Centers for Disease Control, Division of Vector-Borne Diseases in Fort Collins, Colorado, for plague determinations. A titer level of $\geq$ 1:32 was considered positive.

Ten to 20 carcasses at a time were removed from the freezer, weighed to the nearest pound, and submitted to the Montana Department of Livestock Veterinary Diagnostic Laboratory for necropsy.

Carcasses were cursorily examined for ectoparasites prior to necropsy. Those found were collected, fixed in 10% formalin and submitted to the Veterinary Molecular Biology Laboratory for identification.

Gross pathological examinations were conducted on each animal. Sections of brain, lung, liver, spleen, kidney, heart, stomach, intestine, mesenteric lymph nodes, and any abnormal tissues were collected from each animal, fixed in 10% buffered formalin, processed for paraffin embedment, sectioned at 5-7 μm and stained with hematoxylin and eosin. Lung was cultured on blood agar, and ileum was cultured for enteric bacteria, and specifically for *Campylobacter jejuni* and *Salmonella* spp.

A fecal sample was collected from each animal for examination for parasite eggs, oocysts and/or sporocysts by standard sugar flotation. Gastrointestinal tracts were collected and frozen for later examination for endoparasites.

Upper canines were removed from skulls, arranged on a sheet of light cardboard and x-rayed. Juveniles (< 1 year old) were separated from older animals by their large pulp cavity and open, or recently closed, apical foramen. Upper canines from animals older than juveniles were submitted to Matson's Laboratory (Milltown, Montana) for age determination based on cementum annuli counts.

Reproductive tracts were removed from each female collected. The uterus was opened and placental scars, where embryos had been attached to the uterine wall, were counted. Supplemental data was obtained from counts of corpora rubra in sectioned ovaries.

Results

Most data on the three foxes collected will not be presented because they are too few to provide meaningful analysis. Similarly, because of the relatively small sample sizes for each area, most of the coyote results presented are for the total sample unless otherwise noted.

The age distribution of collected coyotes is presented for each sex in Table 1. The sex ratio did not differ from parity, $x^2 = 0.195$, 1 df, $P = 0.659$. The relatively small sample from the Fort Belknap area showed a skewed age structure in which no animal over four years old was found. Juveniles and yearlings represented 21 and 14 percent of the total, respectively. The two- and three-year age classes each comprised 31% of the total, and four-year olds only 3%. By contrast, the south Phillips County sample had a more normal distribution indicative of a relatively unexploited population. Juveniles and yearlings made up 30% and 23% of the total, respectively, while 2- and 3-year olds each comprised only 9% of the total. Animals 4 and older accounted for 28% of south Phillips County specimens, with all age classes through 10 years represented except the 8-year-old class.

Whole weights of collected coyotes are presented by sex and age class in Table 2. In general, mean weights increased with age class for both sexes. Although suffering from sample size deficiencies when separated by area, mean weights of most sex/age groups from Fort Belknap were heavier than their counterparts from south Phillips County.

Based on placental scar counts, 1 of 8 yearlings (12.5%) and 15 of 23 (1 was unusable) adults (65.2%) had pups in 1992. Mean litter size was 3.3 with a range of 1-7.

Serological results (includes Nobuto strips) are summarized in Table 3. Although plague was widespread in south Phillips County coyotes, it was not detected among any animals (including the three foxes) sampled on the Fort Belknap area.

Table 1. Sex and age distribution of coyotes collected for disease surveillance in northcentral Montana, 19-27 January 1993.

	Males	Females	Total
Age Class	% of Total	% of Total	%
0	13	13	27
1	10	10	20
2	5	12	17
3	10	7	17
4	4	5	9
5	2	-	2
6	1	2	4
7	1	1	2
8	-	-	-
9	1	-	1
10	-	1	1
Total	48	52	100

Table 2. Weight (in pounds) of coyotes collected in northcentral Montana, 19-27 January 1993.

	MALES			FEMALES		
		Weight			Weight	
Age	Sample Size	Mean	Range	Sample Size	Mean	Range
0	10	27.7	22-32	11	22.6	19-26
1	7	27.3	22-33	8	24.0	21-28
2+	19	29.5	24-33	23	25.7	20-30

Table 3. Summary of serological results from coyotes collected for disease surveillance in northcentral Montana, 19-27 January 1993. Positive samples include animals of all age classes unless otherwise noted.

Disease	South Phillips County (Percent Positive)	Fork Belknap (Percent Positive)
Plague		
Serology	85	0
Nobuto Strips	64	0
Distemper		
Adults	41	70
Juveniles	0	0
Tularemia	21	10
Toxoplasmosis	23	7
Leptospirosis	0	0

Because plague titers in coyotes become undetectable after 6-8 months (Barnes 1982), the presence of high titer levels confirms that plague was active in south Phillips County the previous summer, as suggested by the die-off of prairie dogs. Low titer levels may represent either building titers from recent exposure, or declining levels following their having peaked. Similarly, negative animals may not have been exposed, or may represent exposure several months previously in which titers have peaked and subsequently returned to undetectable levels. Half of the negative animals from south Phillips County were juveniles, which may represent immigrants not yet exposed to infected prairie dogs.

Titer levels considered indicative of exposure to plague are lower for serologic tests versus Nobuto strips. Therefore, a higher percentage of positive animals occurs among serologic samples when both methods are used on the same animals. There were no cases among our sample in which plague positive animals determined by Nobuto strips were serologically negative.

Canine distemper was not detected in any juvenile animals, but was well represented among animals ≥ one year of age. This suggests that distemper was not active within the year or so prior to our collections, but had been at some time in the year preceding that. It also appears to have been more prevalent on the Fort Belknap area (Table 3).

Leptospirosis was not detected in any specimens (including foxes) from either area. Tularemia and toxoplasmosis were each detected on both areas (including in foxes)

and in all age classes. Prevalence of the latter two diseases was greater in south Phillips County (Table 3).

Attempts were made to collect ectoparasites from 75 of the coyotes and the 3 foxes collected. However, material collected from 24 of the coyotes included only flea parts unidentifiable to genus, or skin debris mistakenly thought to be fleas. Flea species identified and the minimum percentage of coyotes harboring them included *Pulex irritans* (29%), *Pulex* spp. (69%), and *Cediopsylla inaequalis* (20%). Two of the foxes had both *C. inaequalis* and *Pulex* spp., while the other had both *Pulex irritans* and *Pulex* spp. Seven coyotes were visually noted to be affected by mange, but the causative agent was not determined. A louse (*Linognathus* spp., probably *L. setosus*) was collected from a single coyote.

Fecal flotations were done on approximately one-third of the animals collected (25 coyotes and 1 fox). *Toxascaris leonina* occurred in 76% of the coyotes and the single fox examined. *Toxocara canis, Isospora ohioensis*, unidentified ascarid ova, and an unidentified mite egg were the only other parasites detected. Each was found in a single coyote.

Most animals examined had no gross or histopathological lesions other than multiple gunshot wounds. One coyote was diagnosed with focal bronchopneumonia, possibly due to parasitism.

Several species of bacteria were isolated from lung and/or intestinal cultures including: *E. coli, Proteus* spp, *Bacillus* spp., *Streptococcus* spp., *Staphylococcus aureus, Enterobacter* spp., and *Aeromonas hydrophila*. Since no associated lesions were identified, the significance of these isolates is questionable. All attempts to isolate *Salmonella* and *Campylobacter* from the intestine were negative.

Because of the preliminary nature of this data, plus the fact that additional testing is scheduled for 1994, further discussion of the results will be delayed until the total sample is available for analysis.

LITERATURE CITED

Barnes, A. M. 1982. Surveillance and control of bubonic plague in the United States. Symp. Zool. Soc. Lond. 50:237-270.

Thorne, E. T., N. Kingston, W. R. Jolley, and R. C. Bergstrom. 1982. Diseases of wildlife in Wyoming. Wyo. Game and Fish Dept., Cheyenne. 353 pp.

Williams, E. S., E. T. Thorne, M. J. G. Appel, and D. W. Belitsky. 1988. Canine distemper in black-footed ferrets (Mustela nigripes) from Wyoming. Journ. Wildl. Dis. 25:385-398.

____, J. Cavender, C. Lynn, K. Mills, C. Nunamaker, A. Boerger-Fields, B. Luce, and S. Anderson. 1992. Survey for diseases of coyotes and badgers in Shirley Basin, Wyoming in 1991. Pages 75-106 in Oakleaf, B., B. Luce, E. T. Thorne, and S. Torbit, eds. Black-footed ferret reintroduction in Shirley Basin, Wyoming. 1991 ann. compl. rept. Wyo. Game and Fish Dept., Cheyenne. 240 pp.

Wolff, K. L., and B. W. Hudson. 1974. Paper-strip blood-sampling technique for the detection of antibody to the plague organism Yersinia pestis. Appl. Microbiol. 28(2):323-325.